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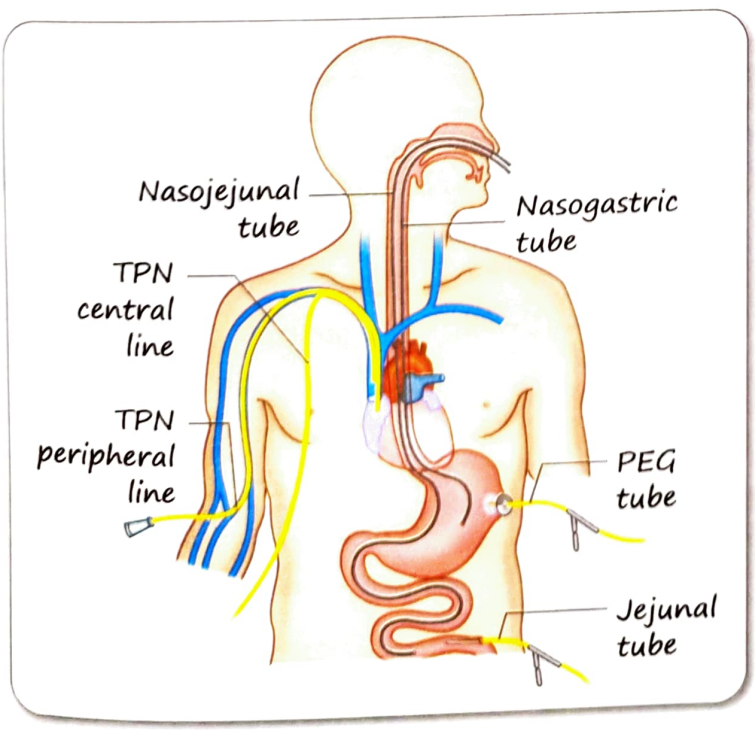
NUTRITION

- The best method to assess the nutrition in a surgical patient is serum albumin.
- Malnutrition universal screening tool (MUST) is a clinical tool to assess nutrition based on:
  - BMI
  - Weight loss in 3–6 months
  - Acute disease effect

Differences Between Enteral and Parenteral Nutrition

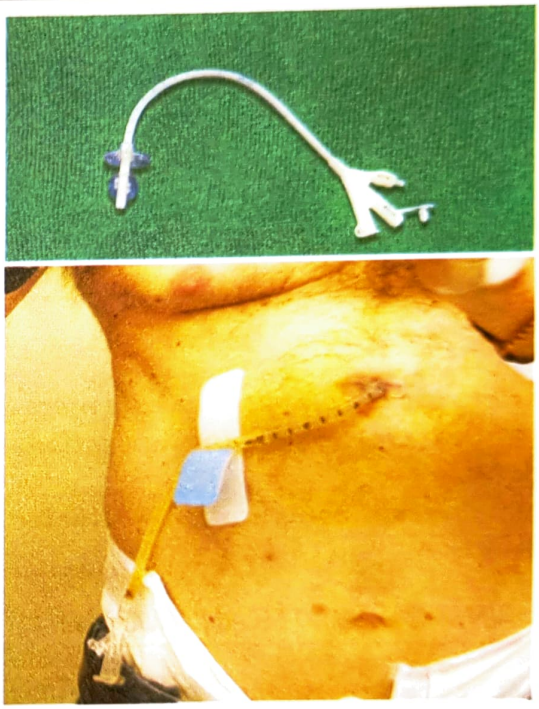
Enteral nutrition	Parenteral nutrition
Nutrition given via GI tract	**Nutrition given via veins**
Tube feeding • Nasogastric tube (Ryle's tube) • Nasojejunal tube • Percutaneous endoscopic gastrostomy tube • Feeding gastrostomy • Feeding jejunostomy	• Peripheral parenteral • Central parenteral



PEG tube

Nasogastric Tube: (Ryle's Tube)

- Ideal length of tube used is calculated by NEX rule (nose to ear to xiphoid process measured).
- Ryles tube is inserted by making the patient sit and keeping the neck flexed.
- Position of Ryles tube in stomach is confirmed by testing the aspirate for pH using litmus paper.



Parenteral Nutrition Types

- **Peripheral PN (<2 weeks)**
  - Peripherally inserted central catheter
  - Hickman lines
- **Central PN (>2 weeks)**
  - IJV, SCV, FV are used

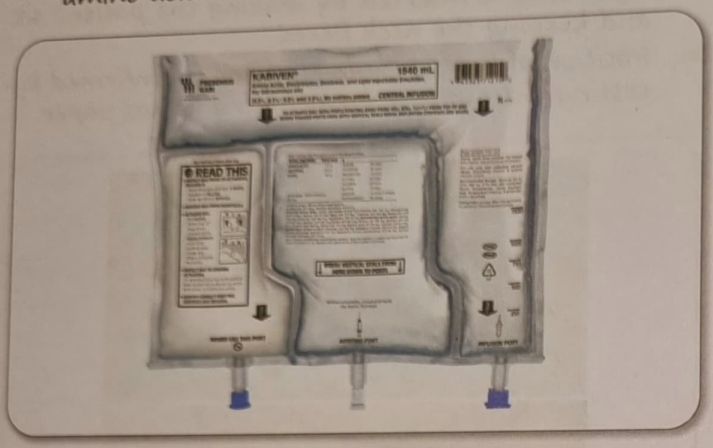
Best Vein to Give Nutrition by Central Vein

- For Elective cases—Subclavian Vein
- For Trauma cases—IJV
- Highest chance of Pneumothorax—SCV
- Most commonly used vein—IJV
- For long-term nutrition—SCV is best
- Risk of thrombosis is highest with Femoral vein route
- Risk of infection is highest with Femoral vein > IJV > SCV > Hickman line

Total Parenteral Nutrition

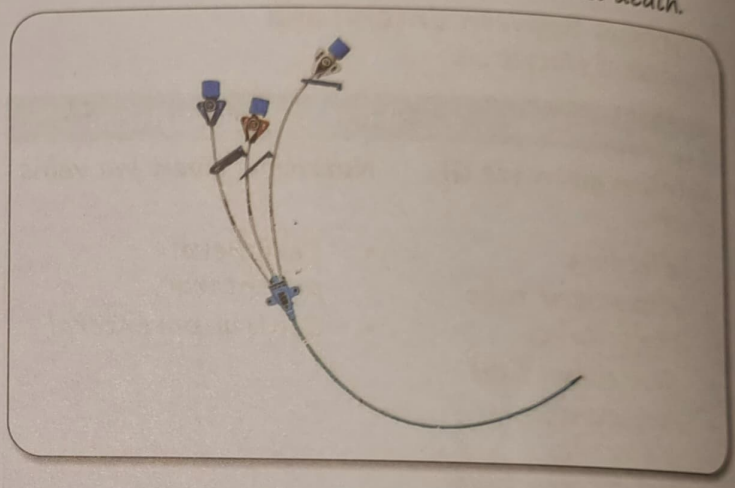
Components of TPN

- 60% carbohydrates (dextran), 20% protein (amino acids), 20% lipids (fat)
- Fat free TPN—3:1 ratio of only dextrans and amino acids



Complications of TPN

- **Catheter related complications are more common:**
  - MC procedure related complication—arterial puncture
  - MC overall complication—catheter related infection
  - Most dangerous complication—tension pneumothorax
- **Refeeding syndrome:**
  - Characterized by severe fluid and electrolyte shifts in malnourished patients undergoing refeeding*
  - It can occur with enteral and parenteral nutrition (MC with TPN)
  - Lab values: **Hypophosphatemia, hypocalcemia, Hypomagnesemia*** and also hypokalemia (Mnemonic—PCM*)
  - Hypokalemia can induce cardiac arrhythmias and congestive cardiac failure and death.



Central vein catheter

SHOCK AND BLOOD TRANSFUSION

Differences between Hypovolemic and Distributive Shock

Features	Hypovolemic shock (hemorrhagic shock)	Distributive shock (septic shock)
Cardiac output	Decreased	Increased
Peripheral vascular resistance	Increased (cold peripheries)	Decreased (warm peripheries)
Oxygen consumption	Increased	Decreased
Venous resistance	Low	Low
Mixed venous oxygen saturation (MVOS) Normal—50–70%	MVOS <50%**	MVOS >70%**

Change in Parameters

Parameters	Hypovolemic shock	Cardiogenic shock	Neurogenic shock	Anaphylactic shock	Septic shock
Pulse rate	↑↑	↑/↓	↓	↑↑	↑
Systolic Blood pressure	↓↓	↓	↓	↓	↑
Cardiac Output	↓↓	↓	↓	↓	↑
Peripheral vascular resistance	↑	↑	↓	↓	↓

Note: *Repeated question
**Multiple times repeated question

Differences between Urine Output, CVP and Serum Lactate

Urine output	CVP	Serum Lactate
• Best clinical parameter • Best clinical method to look for adequacy of resuscitation • Best to look for tissue perfusion.	• Best method to calculate amount of fluid to be given and dose of drug to be given • CVP is not accurate for cardiogenic shock and septic shock.	• Best lab value to monitor tissue perfusion • <2 mmol/L good resuscitation • >5 mmol/L bad resuscitation • Best method to look for muscle and GIT perfusion.

Hemorrhagic Shock

- **Four classes of hemorrhagic shock:** Class 1, 2, 3, 4 based on amount of blood lost.
- Class 1 (<750 mL), Class 2 (750–1500 mL), Class 3 (1500–2000 mL) and Class 4 (>2000 mL)
- Pulse rate and respiratory rate increase; and Pulse pressure decreases from class 2 shock
- BP falls from class 3 shock

Septic Shock

- **SIRS is defined by:**
  Two or more of the following: (Mnemonic—Orthopedics Love THR)
  - L—Leukocyte Count (>12000 or <4000)
  - T—Temperature >38°C or <35°C
  - H—Heart rate >90 beats/min
  - R—Respiratory rate >20/min ($PaCO_2$ <32 mm Hg)
- **Quick Sequential Organ Failure Assessment Score (qSOFA score)**
  (Mnemonic—Royal Challengers Bangalore will be in SOFA)
  - R—Respiratory rate – >22/min – 1 point
  - C—Confused mental status – 1 point
  - B—BP <100 mm Hg – 1 point

  ≥2 point indicates organ dysfunction. Score >2 carries 10% mortality

Blood Products and Complications

Whole blood

- Available as 450 mL pack.
- Contains RBC, WBC, plasma, platelet of which WBC and platelet are nonfunctional**

Packed red cells

- The cells are spun down and concentrated.
- **Each unit is 330 mL***
- Stored at 2°–6°C.

Fresh frozen plasma

- Rich in coagulation factors
- Stored at –40°C to –60°C. (2-year shelf life)*

Cryoprecipitate

- Supernatant precipitate of FFP and is rich in factor VIII* and fibrinogen.
- Stored at –30°C with a 2-year shelf life*

Platelets

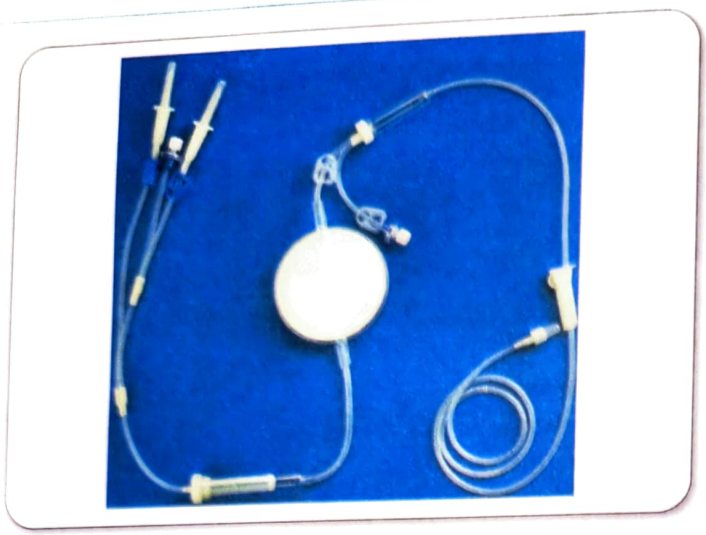
- Mostly used in dengue fever cases*
- Platelets are stored on a special agitator at 20°–24°C (Room temperature)
- Half-life only 5 days* as a fresh component
- Useful in patients with thrombocytopenia

Complications of Blood Transfusion

Febrile nonhemolytic transfusion reaction* (most common)—due to WBC present—leukocyte reduction filters remove the WBC*. To avoid this reaction—leukocyte reduction filter is used.

Complications of Massive Transfusion: (>10 Units of Blood/day in Adults)

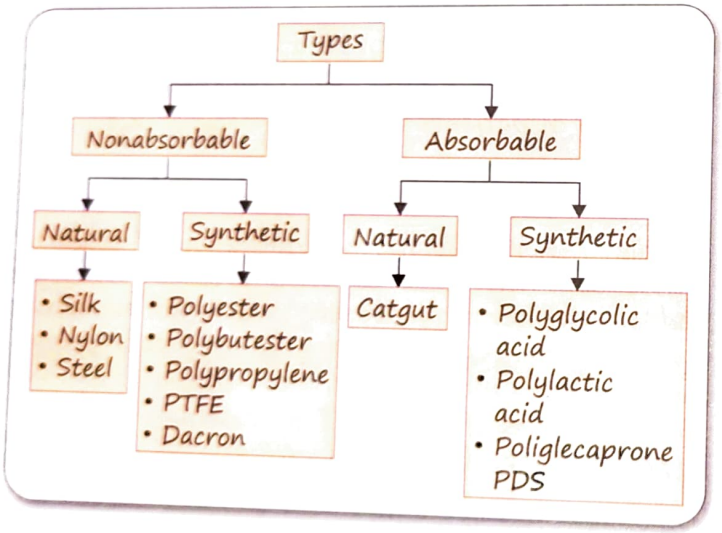
- Coagulopathy
- Hypocalcemia* (due to binding of ionized calcium by citrate used as anticoagulant)
- Hyperkalemia* (due to RBC lysis)
- Hypokalemia also can happen
- Hypomagnesemia
- Hypothermia
- Dilutional thrombocytopenia
- Decreased oxygen delivery (due to decrease in 2, 3 DPG)
- Metabolic alkalosis (even though the stored blood contains pH – 6.3, because of massive transfusion sodium citrate is metabolized in liver to sodium bicarbonate)
- Rare-metabolic acidosis*



Leukocyte reduction filter

SUTURES AND KNOTS

Sutures



Nonabsorbable Synthetic Suture Materials

Polypropylene

- Blue color
- Monofilament materials
- Coiling back is seen, known as MEMORY
- Applications of prolene:
  - Hernia repair
  - Hernia mesh
  - Vascular suturing (Aorta, femoral artery)
  - Tendon repair (like Tendo achilles)

Poly Tetra Fluoro Ethylene (PTFE)

Graft materials for Femoral artery, Popliteal artery.

Dacron

Graft material for aorta replacement

Natural Absorbable

Catgut

- Brown in color
- Plain—10 days
- Chromic—90 days
- **Tensile strength:** Plain catgut—7–10 days, Chromic catgut—21–28 days
- Storage solution of Catgut—Isopropyl Alcohol
- **Applications:**
  - Subcutaneous
  - Muscle approximations
  - Plain catgut—circumcision
- Highest enzymatic reaction, hence banned in UK
- Absorbed by enzymatic degradation.

Synthetic Absorbable

Polyglycolic acid: (Vicryl)—"Work Horse" material in theater

- Multifilament material (made up of Glycolic acid + Lactic acid copolymers)—as it is multifilament it has good knotting capacity but increased infection.
- Violet color
- Absorption period—60–90 days
- Absorbed by Hydrolysis
- **Types of Vicryl:**
  - Barbed vicryl—No knotting needed, used in facelift sutures, plastic surgery
  - Vicryl plus—Antibiotic coated (trichlosan antibiotic)
  - Vicryl rapide—Absorbed in 10 days
  - White vicryl (MONOCRYL)—Poliglecaprone (Monofilament material)—Suture of choice for Subcuticular sutures in skin (Cosmetic skin closure), complete absorption occurs in 90–120 days.
- **Applications:**
  - Bowel anastomosis (3'0 vicryl)
  - Bile duct anastomosis (4'0 vicryl)
  - Muscle closure
  - Subcutaneous closure
  - Vicryl meshes (Inner side of dual mesh to prevent bowel adhesions)
- Pancreatic duct—Vicryl must not be used (use only prolene or PDS)

Polydioxanone

- Longest absorption period—complete absorption occurs in 180 days.
- Used for Linea alba closures
- Used for tracheobronchial repairs

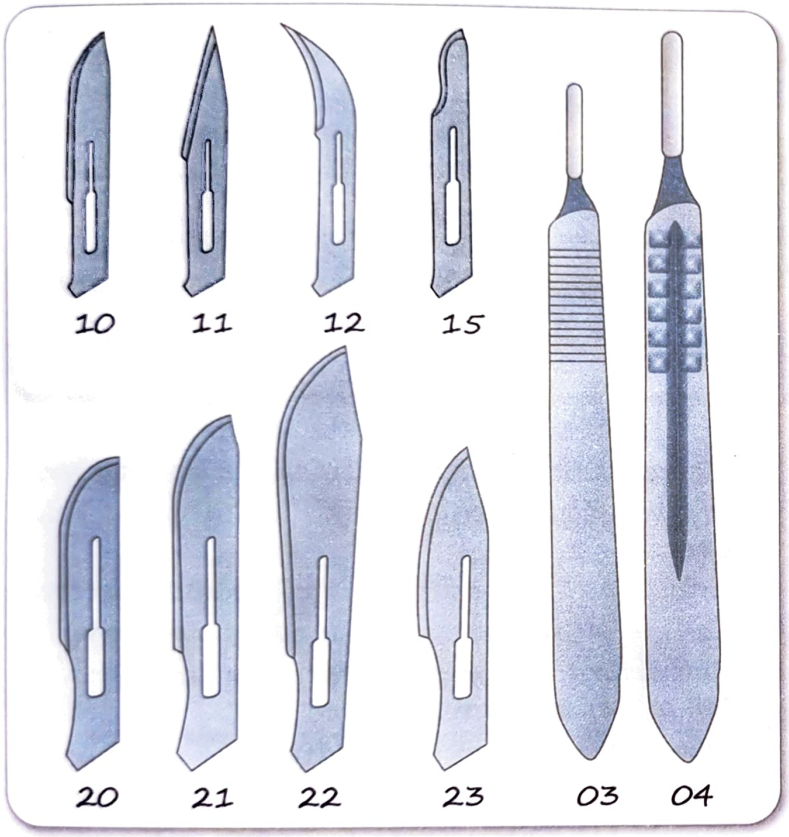
Blades and Handles

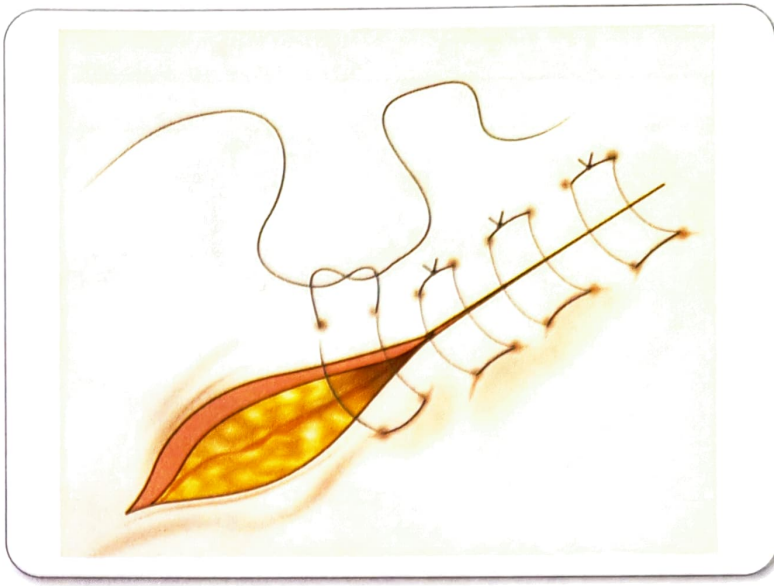
Most important Blades for exam are discussed here:

- **11 Size blade:** For stab incision and for arteriotomy
- **15 Size blade:** For Fine small skin incision
- **20 and 22 Size blades:** For long Incisions like laparotomy and thoracotomy

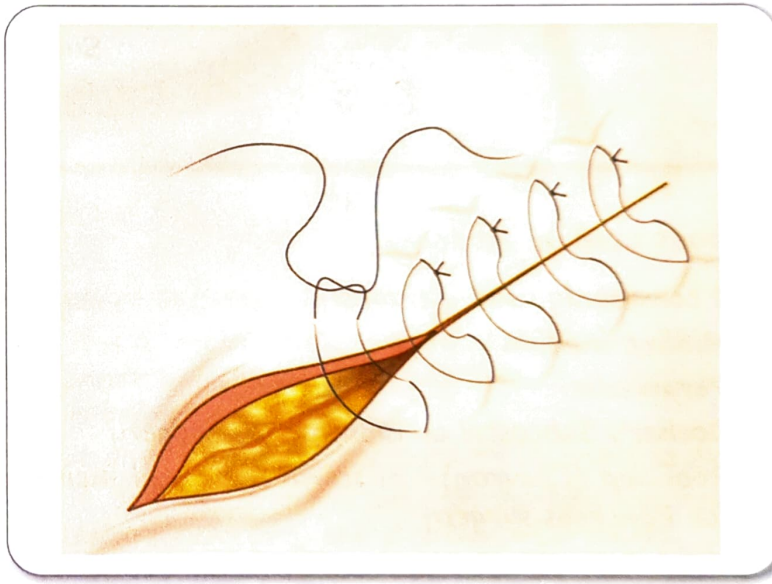
The handles used to fix the blades are known as Bard Parker (BP) Handles.

- BP handle 3 for holding—10, 11 and 15 size blades
- BP handle 4 for holding—20 and 22 size blades



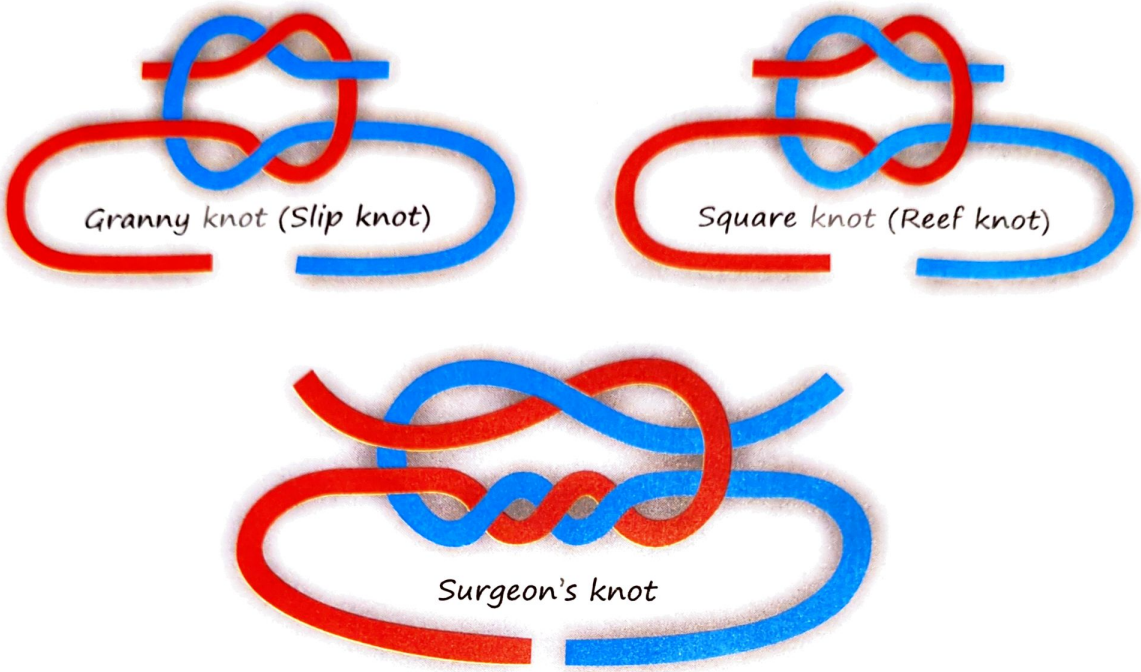


Horizontal mattress



Vertical mattress

Remember the Knots

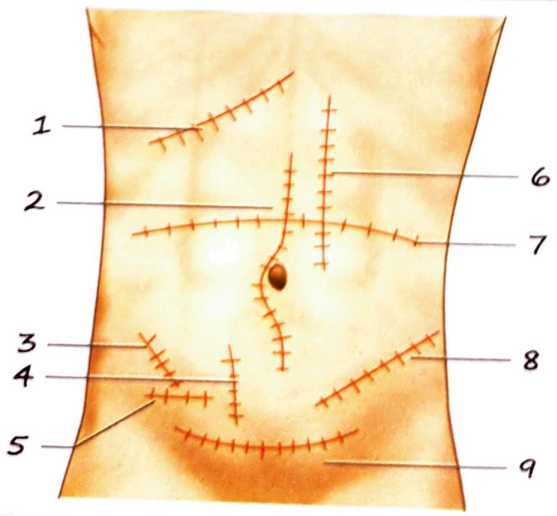


Incisions used on Abdomen

Most commonly used incisions:

- Midline incision
- Paramedian
- Kocher's Subcostal incision for GB surgery
- Roof top (Chevron)—Bilateral Subcostal incision for Pancreas surgery
- Mercedes Benz shaped incision for liver surgery
- Pfannenstiel incision—for LSCS and Pelvic operations
- Grid Iron (Mc Arthur) incision for appendectomy
- Lanz—Horizontal incision for Appendectomy
- Rutherford Morrison—Muscle cutting incision" (all others are skin incisions)
- Transverse incision for children

SKIN SUTURES



Various abdominal incisions:

1. Kocher incision
2. Midline incision
3. McBurney incision
4. Battle incision
5. Lanz incision
6. Paramedian incision
7. Transverse incision
8. Rutherford Morrison incision
9. Pfannenstiel incision

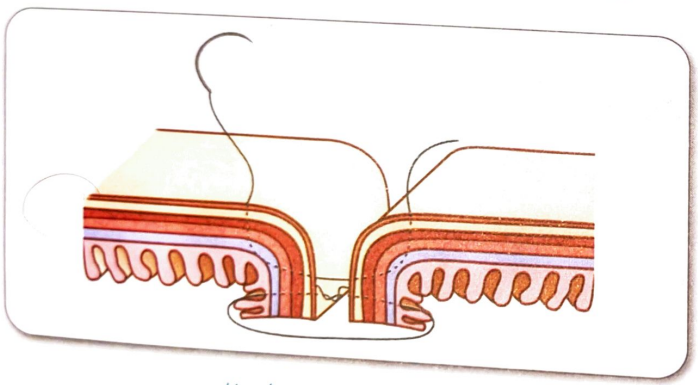
Removal of Skin Sutures

When to remove the skin sutures?

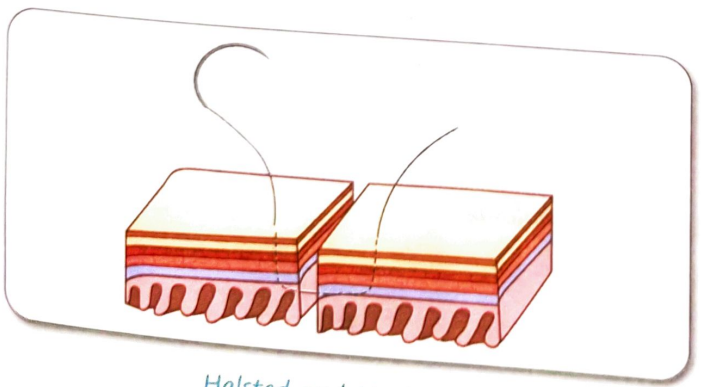
- Scalp—6–8 days
- 3–5 days—Lids, lips and face
- 8–10 days—Laparotomy, thoracotomy, ear lobe repair
- 10–14 days—Palms and soles, back

Bowel Anastomosis Techniques

- **Kocher's technique of bowel anastomosis**—Two-layer closure of Bowel anastomosis
- Halsted and Matheson method—Single layer extramucosal intermittent anastomosis (submucosa included)
- Most stable layer used for anastomosis—**Submucosa** because it contains high amount of collagen
- Current preferred method for anastomosis is Halsted and Matheson extramucosal method

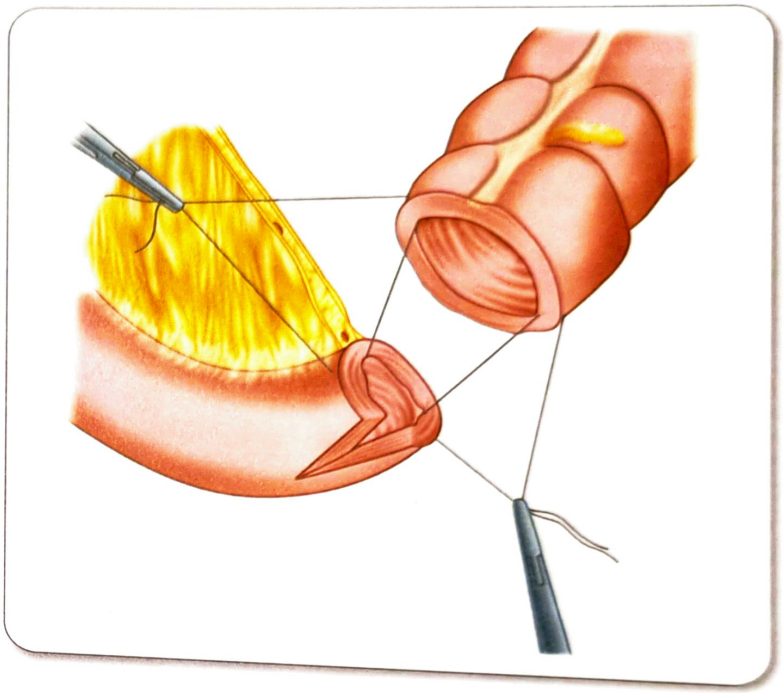


Kocher's technique



Halsted and Matheson

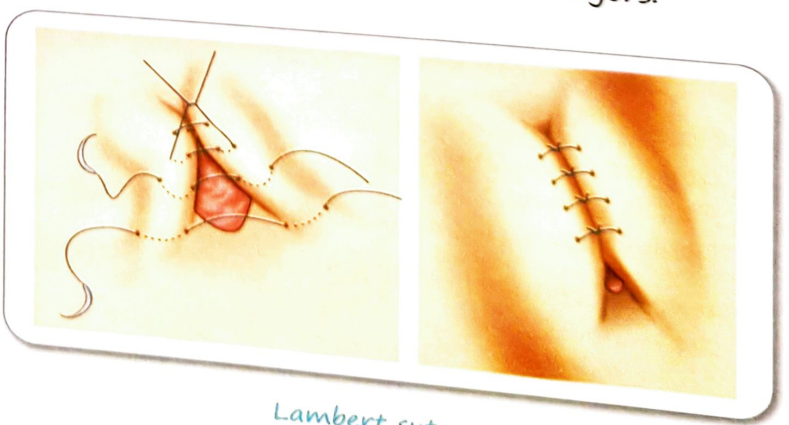
Cheatle cut: Approximate disproportionate bowel by end to end anastomosis*



Cheatle cut

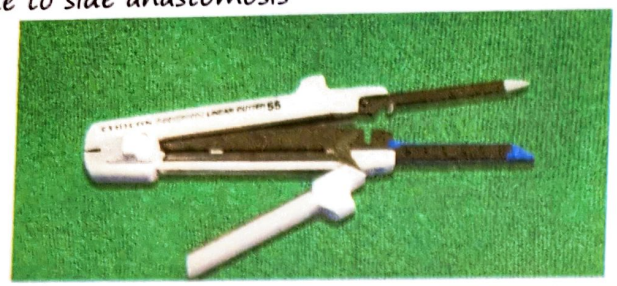
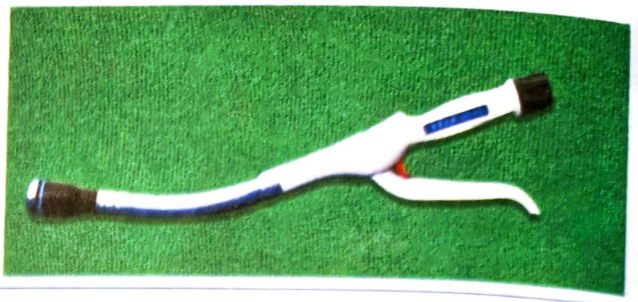
Lambert Sutures

- It is a seromuscular suture of the bowel after the inner full thickness or extramucosal anastomosis is being done.
- It gives an additional support to anastomosis.
- It can be intermittent or continuous but the suture runs only the seromuscular layers.



Lambert suture

Stapler Anastomosis of Bowel

Linear stapler (Transverse Linear Cutter—TLC)	Circular stapler (EEA—End to End anastomosis staplers)
Side to side anastomosis 	End to End anastomosis 

OPERATION THEATER INSTRUMENTS AND PROTOCOLS

Surgical Safety List (WHO UK Process)

- Sign in Check done before induction of anesthesia*
- Time out Check done before Skin incision*
- Sign out Check done before patient leaves operating room**
- Please remember there is no column known as Time in**

Sign in	Time out	Sign out
• Name • Identity • Confirm the disease • Site marked or not • Written consent • H/o drug allergy • Associated diseases	• Discussion between Surgeon and anesthetist. • Anticipated time of surgery and blood loss • Prophylactic antibiotics given or not is noted.	• Look for gauze count, instrument count • Any instrument problem is addressed here.

- Best method to prevent operating wrong limb—surgeon and anesthetist examining each other separately.

Universal Precaution Kit: (Personal Protective Equipment Kit)

- Boots
- Goggles (Face shield)
- Plastic Gowns
- Double gloves (Inside wear bigger gloves and outside your size gloves)

Sequence of removal of PPE after surgery (Recent AIIMS)—Mnemonic- GFPF

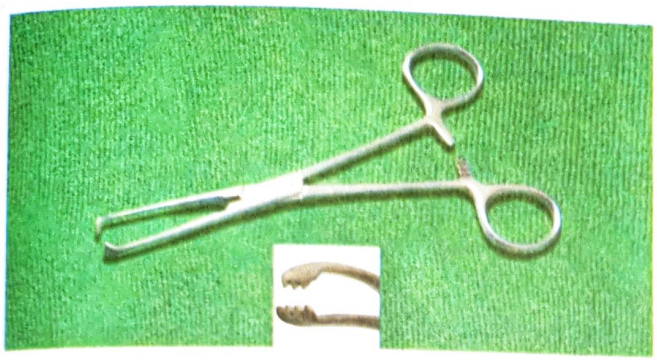
- 1st—Gloves
- 2nd—Face shield/Goggles
- 3rd—Plastic Gown/Aprons
- 4th—Facemask/respirator

MC Finger injured during surgery- Nondominant hand index finger*

- Hollow needles have more risk of injury than surgical needles.

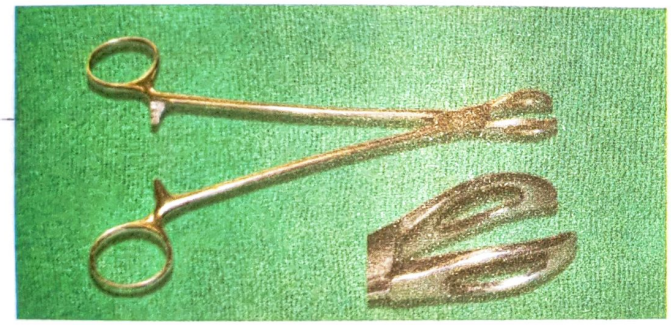
Instruments used in operation theater

Allis Tissue Forceps



- Allis forceps for holding the tissues firmly*
- Used during laparotomy to hold the skin margins.
- Used to hold skin flaps during excision of Lipoma, Sebaceous cyst.
- It is helpful in creating flaps during thyroid surgeries*

Lane's Tissue Forceps



- Used to hold structures very tight.
- It is used to hold submandibular gland and Parotid gland during dissection from adjacent structures.
- Helps in holding breast during mastectomy.
- Also helpful like a towel clip to hold the suction tubes, draping sheet.

Babcock's Forceps

- Used to hold tissues very softly.
- The ideal instrument to hold and grasp the bowel and appendix during surgery*
- Hold the margins of stomach or small intestine during anastomosis*

Contd...

Instruments used in operation theater

Instruments used in Skin Suturing:

- Needle Holder
- Toothed forceps
- Straight scissors

Curved Scissors not used to cut sutures, only used to cut tissues.

Curved artery forceps—To catch the bleeding vessels

Straight artery Forceps—To hold tissues

Cheatle Forceps

- It is used to pick instruments and mopping pads/gauzes from bin in a sterile way.
- It is kept in a sterile bottle container.

Langenbeck Retractor

- Used to retract tissues during hernia surgery, appendectomy, etc.
- Available in various sizes.

Contd...

Instruments used in operation theater

Morris Retractor

- Used to retract the abdominal wall in a wide manner.
- It is the instrument of choice for retraction in left subcostal region because it avoids the risk of splenic injury*

Czerny Retractor

- Serves the same purpose of a Langenbeck retractor, but has another limb with a double hook with space in between.
- Sutures can be made in the tissues between the gap of hooks.

Deaver Retractor

- Used to retract liver without any damage to liver parenchyma.
- Used during Cholecystectomy to retract liver.
- Used in places where a careful retraction without organ damage is needed.

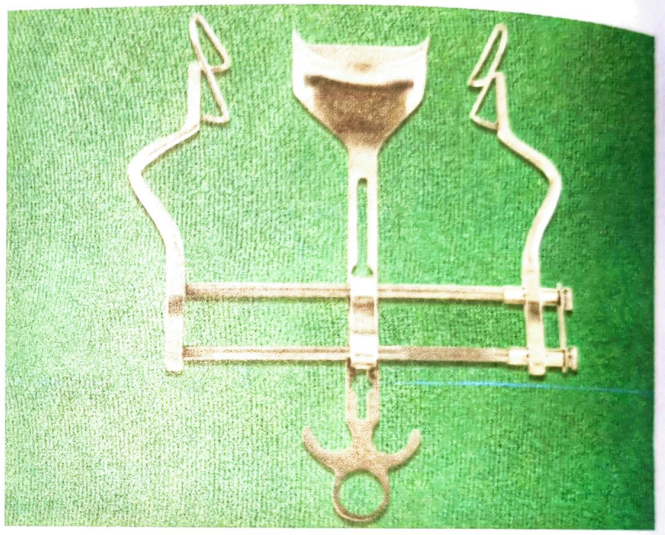
Contd...

Instruments used in operation theater

Doyen's Retractor

To retract the pelvis and bladder at pubic symphysis.

Balfour Abdominal Self-Retaining Retractor



- It is used to retract the lateral abdominal walls.
- The third limb—used to retract the bladder downward.

Joll's Self-Retaining Thyroid Retractor

- Used during thyroidectomy* to retract the platysma.
- It is a self-retaining retractor.

Contd...

Instruments used in operation theater

Towel Clips

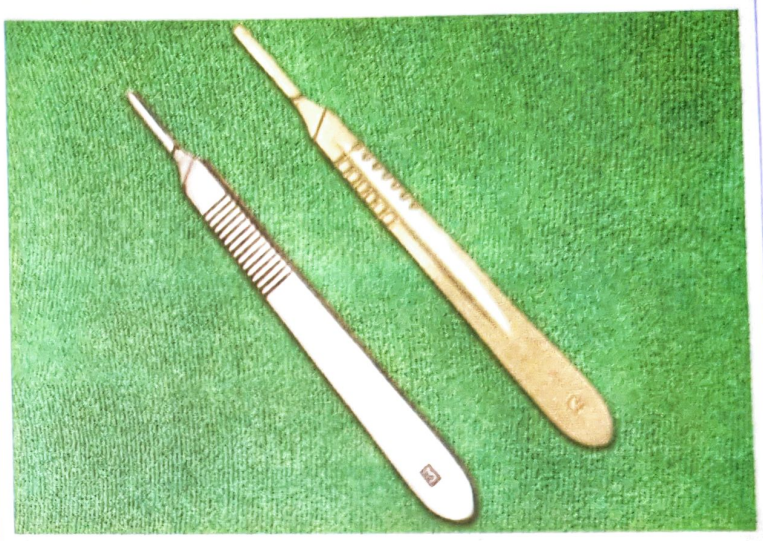
- Towel clips are used to hold the sterile dressing after drap in position*.
- Some surgeons use this to hold and retract the tongue outside for intraoral surgeries.

Contd...

Instruments used in operation theater

Blade Handles: (Bard Parker Handles)

- 3 size to load – 11 size blade and 15 size blade
- 4 size to load – 22 Size blade



Cannulas

Color codes of Cannulas

Gauge	Color code	Catheter		
		Ext. Dia. "mm"	Length "mm"	Flow rate "mL/min"
G 14	Orange	2.1	45	270
G 16	Gray	1.8	45	200
G 17	White	1.5	45	140
G 18	Green	1.3	45	85
G 20	Pink	1.1	33	55
G 22	Blue	0.9	25	33
G 24	Yellow	0.7	19	18
G 26	Violet	0.6	19	10

- To infuse maximum fluids in dehydration and diarrhea, the ideal cannula is GRAY—16G. **(From the Table note- 200 mL/minute using Gray" and 85 mL/min using Green)**
- In Trauma, we use short and wide bore 2 Cannulas of at least 18 Gauge—2 in numbers as per ATLS guidelines*

Foley Catheter

Materials Used

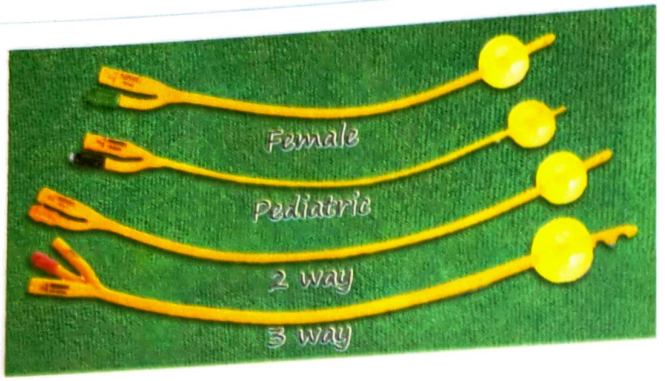
- Latex rubber
- Silicon

Silicon catheter

- Less chances of encrustation and calcification and hence, less changing of catheter needed (once in 3 months)

Latex rubber catheter

- Increased risk of infection
- Hypersensitivity
- Irritation of bladder mucosa
- Must be changed once in a month



Color Codes for Foley and Size

Color code	Size
Black	8 Fr
Gray	10 Fr
White	12 Fr
Green	14 Fr
Orange	16 Fr
Red	18 Fr
Yellow	20 Fr
Purple	22 Fr
Blue	24 Fr

- MC used is orange (16 Fr)
- Women: 12–14 Fr, Men 16–18 Fr catheter is used,
- Three Way Foley Catheter is used for—**Bladder irrigation**, Commonly used after Prostate Surgery—TURP.
- In case of retention of Foley inside bladder and unable to remove the Foley catheter—we rupture the Foley Bulb using USG guidance.
- 1 mm = 3 French in units (or) 1 French = 0.33 mm
- The size mentioned in Foley catheter is based on **Outer Diameter of the Catheter"**
- Balloon is inflated with sterile water only. Saline and air must not be used. Saline may cause blockage with crystals.
- In case of retained Foley how to remove it ideally—USG guided Puncture of Balloon

Energy Devices in Operation Theater

Diathermy

Diathermy is a machine which converts electrical energy into heat energy.

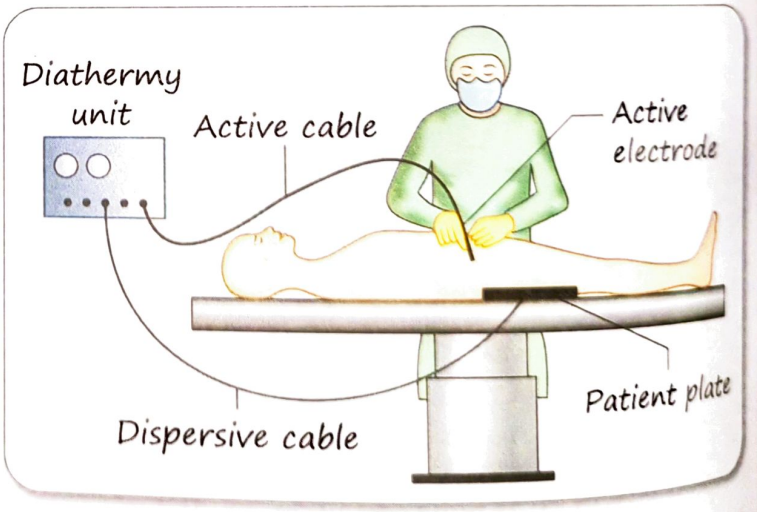
Diathermy machine

- Yellow button in the pencil is for cutting (Continuous Waveforms).
- Blue button in the pencil is for coagulation (Intermittent Waveforms).
- Earth plate prevents electric shock to patient.

Diathermy can be used for three purposes:

1. **Coagulation:** The sealing of blood vessels.
2. **Cutting:** Used to divide tissues during bloodless surgery.
3. **Fulguration:** The destructive coagulation of tissues with charring. It is a blended current which uses both the above forms of diathermy activity.

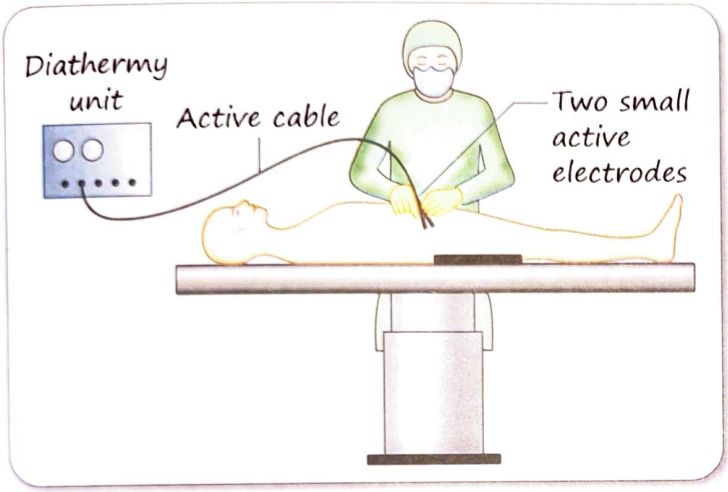
Monopolar Diathermy



- **Monopolar diathermy:** The electrical energy is passed via the diathermy probe and returned to the machine via the patient earth plate as shown in the image given above.
- MC complication inside OT is diathermy burns".
- **Pacemaker containing patients** must be carefully watched during monopolar diathermy and earth plate must be far away from pacemaker.

- Contraindications of Monopolar Diathermy:
  - Fingertips
  - Penis (Circumcision)
  - Thyroid and parotid surgery near nerves

Bipolar Diathermy



- Bipolar diathermy needs no earth plate.
- The current is passed between the limbs of diathermy probe.
- Safe in surgeries near nerve and circumcision.
- Can be safely used in pacemakers.

Please note the Bipolar (Left) and Monopolar (Right) Probes

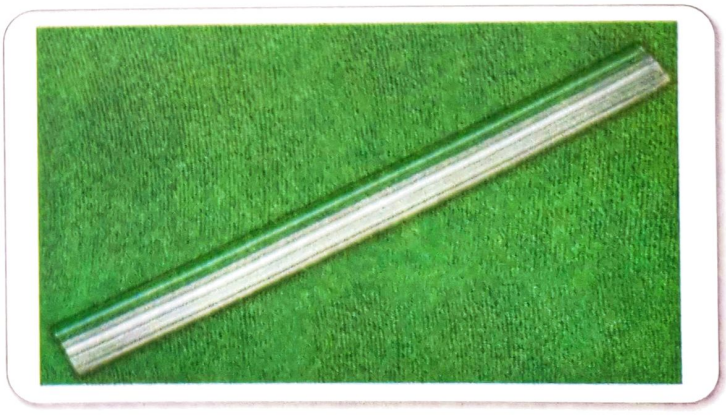
Harmonic Scalpel

- The harmonic scalpel is an instrument that uses ultrasound technology to cut tissues while simultaneously sealing them and utilizes a hand-held ultrasound transducer and scalpel at frequency of 20,000–50,000 Hz.
- Protein denaturation is caused by vibration" rather than heat.

DRAINS IN SURGERY

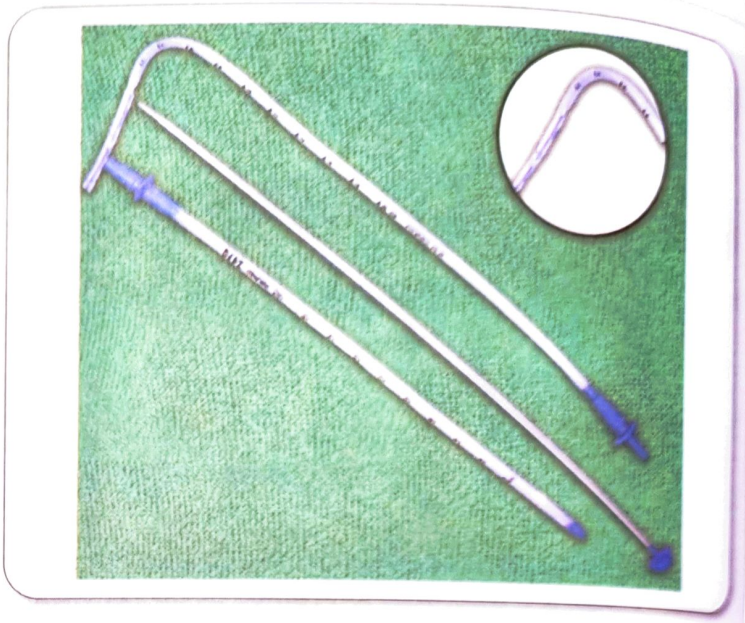
Differences between open and closed drains

Open drains	Closed drains
• Include Corrugated Rubber or Plastic Drains	Consist of tubes draining into a bag or Bottle
• Drain fluid collects in a pad or Stoma bag	Abdominal drains, ICD drains, suction drains are examples
• Increased risk of infection seen	Infection risk is less
• Corrugated rubber drain is an open drain	Vacuum suction and Jackson Pratt are all closed drains

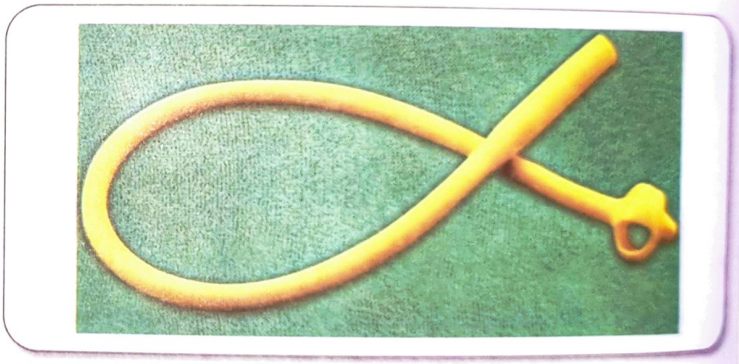


Corrugated rubber open drain

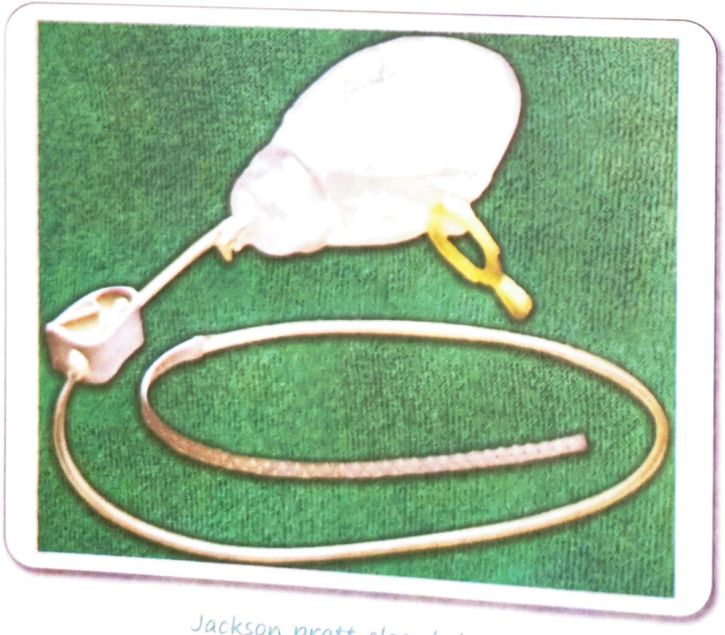
Closed suction drain



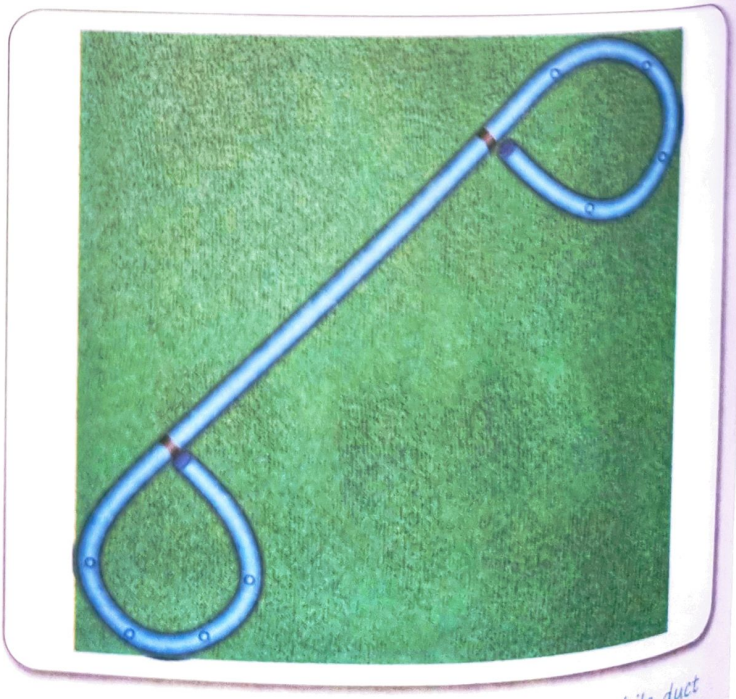
Intercostal drain tube



Malecot self-retaining catheter drain



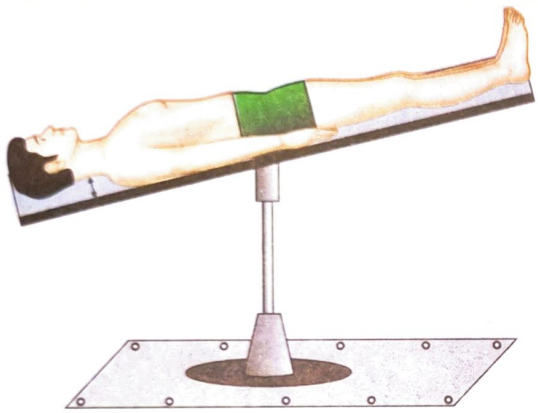
Jackson pratt closed drain



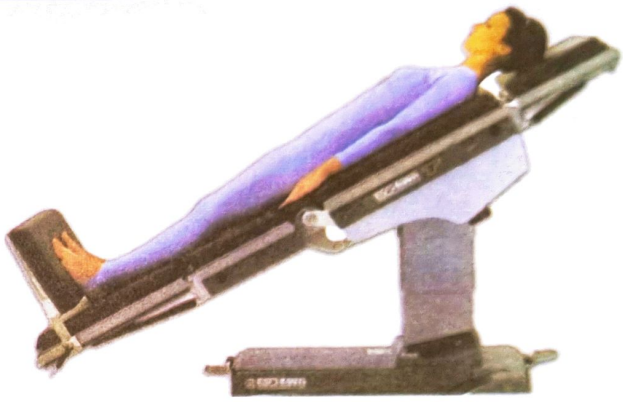
Double pig tail stent (double j stent)—ureter, bile duct

Place of drain	Purpose	Removal after
Thyroid surgery	To identify bleeding	24 hours
Breast surgery	To remove Serous Discharge	5 Days
ICD drain	To drain Collections	Collection <20 mL/day
T Tube Drain	To Drain Bile	10–14th POD
Pelvic drain after Colorectal anastomosis	To identify leakage	7th POD

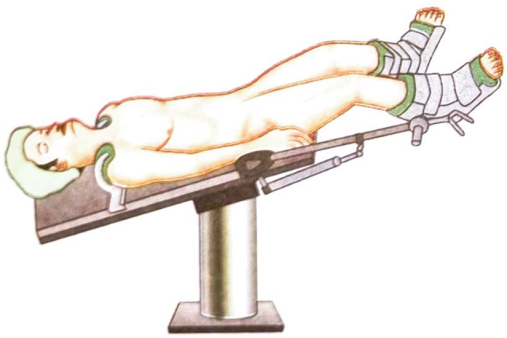
POSITIONS OF PATIENTS IN OPERATION THEATER



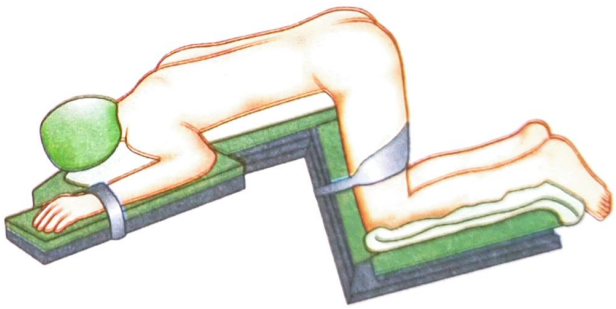
Trendelenburg
Varicose Vein Surgery



Reverse Trendelenburg:
Thyroid Surgeries

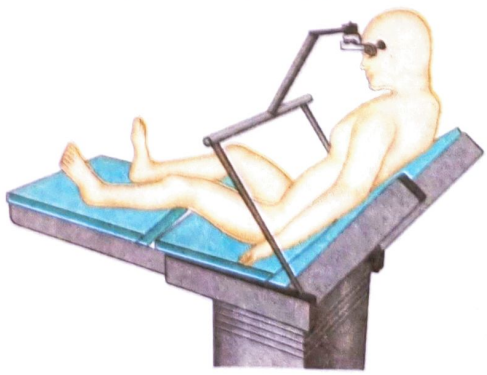


Lloyd-Davies position
- Trendelenburg + Leg Split
- Laparoscopy procedures



Jack knife position
- Prone Position
- Pilonidal sinus operated
- Positional Asphyxia may happen

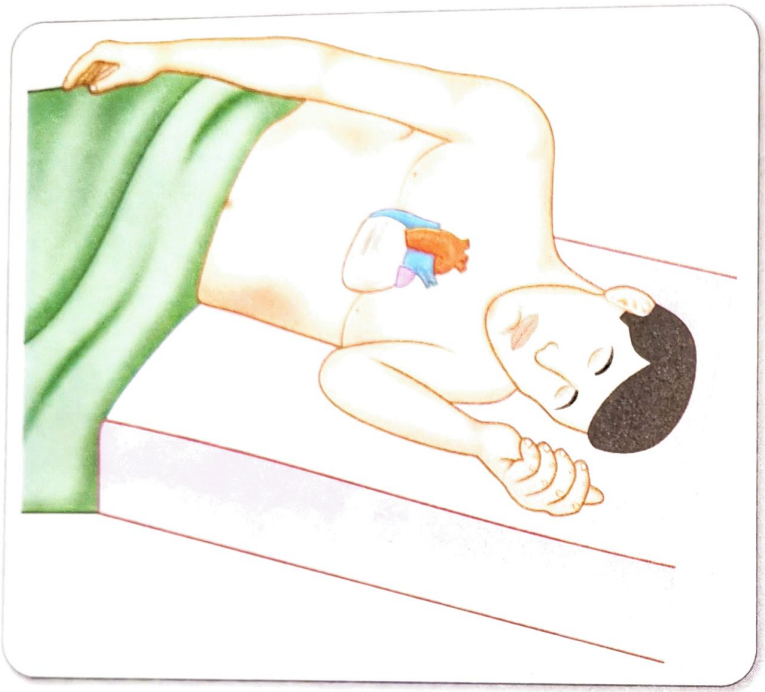
Lithotomy Position
- Gynecology procedures
- Injury to Common Peroneal nerve can happen



Sitting position:
- Neurosurgery
- Air embolism can happen

DURANT'S POSITION/MANEUVER

A position used in air embolism in which the patient is immediately put in left lateral decubitus with head low position (Trendelenburg) so that gas will remain in the apex of ventricle and may be aspirated under Echo guidance.



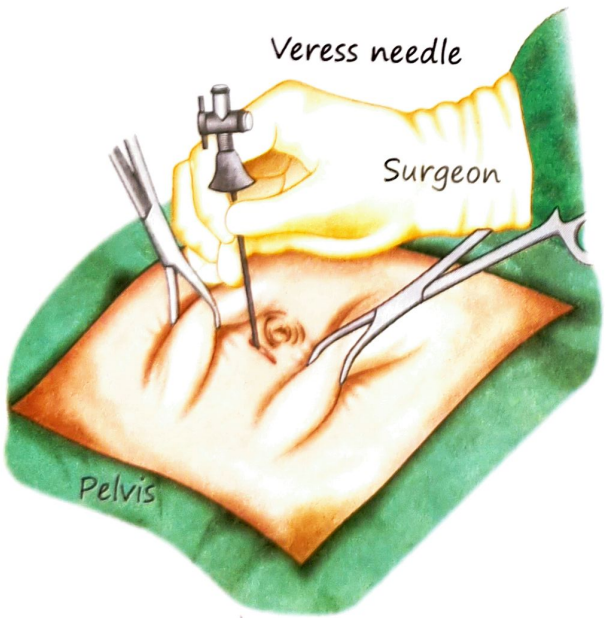
ADVANCES IN SURGERY

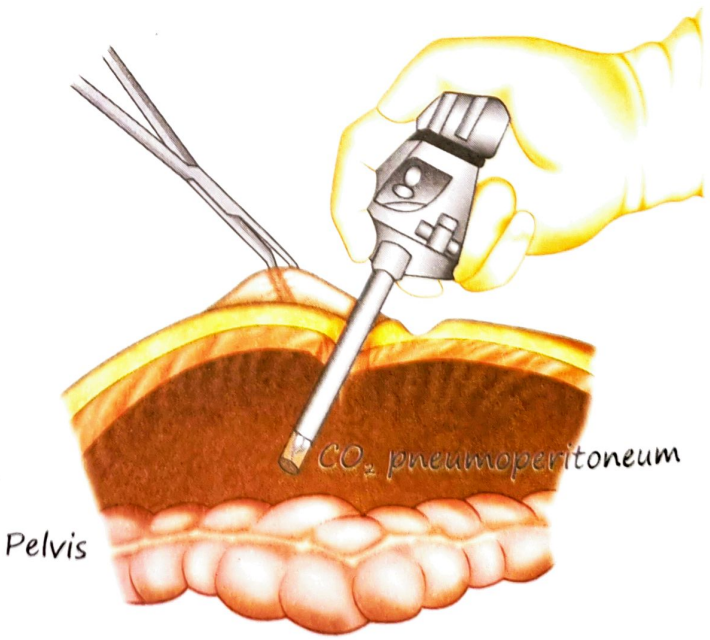
Laparoscopic Surgery

- Insufflation of gas in peritoneal cavity and operating via small holes.
- **Gases used**: Carbon Dioxide(MC), Nitrogen, Air
- Carbon dioxide is rapidly absorbable and causes less postoperative pain and less incidence of fat embolism**.
- CO_2 is 200 times more diffusible and rapidly cleared from circulation*.
- Intraperitoneal pressure maintained during surgery- 12-15 mm Hg**
- **Laparoscopy pneumoperitoneum is created by two methods**: Open and Closed method

Differences between open and closed method

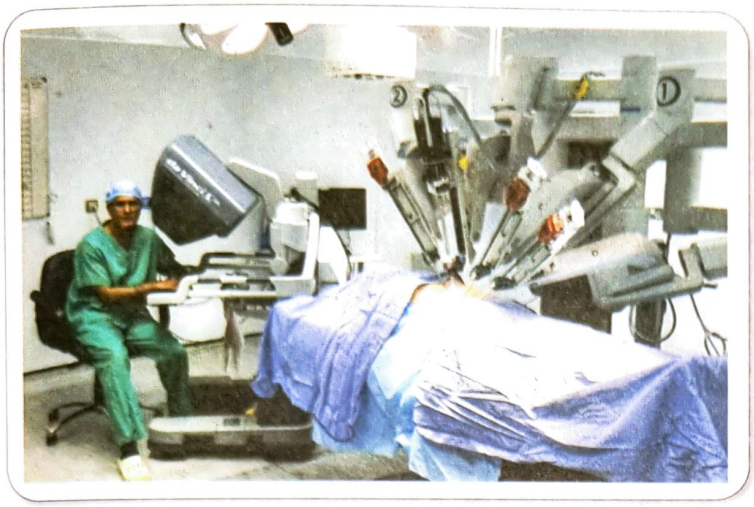
Open method	Closed method
Using Hassan's Cannula	Using Veress needle
Risk of major vessel injury is less	Risk of bowel injury is less as it has safety valve at tip.
Trocar penetrates—Skin, Superficial and Deep fascia, Fascia Transversalis, parietal peritoneum.	





Robotic Surgery

- da Vinci Robot*



- Docking—Inserting the limbs of Robot inside
- Major Advantages:
  - Eliminates tremors of the surgeon
  - Multidirectional movement—7 degrees of freedom
  - Tele robotic Surgery can be done

TYPES OF SURGERIES

- **Outpatient surgery:** Not admitted to a ward facility
- **Procedure room surgery:** Surgery not requiring full sterile theater facilities
- **Day or same-day surgery:** Admitted and discharged within the 12-hour day**
- **Overnight stay:** 23-hour admission with early morning discharge
- **Short-stay surgery:** Admission for up to 72 hours

Day Care Surgery

Definitions:

- **Day Surgery**—Patient was admitted in Hospital for 12 hours only**
- **Overnight Stay Surgery**—Patient needs '23 hour stay'
- **Short stay Surgery**—72 hours admission

Criteria for Day Care Surgery

Medical Criteria

- Age—No upper limit
- ASA—Grade 1, 2
- BMI <40 is essential

Social Criteria

- Responsible adult available to take care for 24 hours
- House should be situated at a distance of less than one hour

Surgical Criteria

- Surgery up to two hours only
- Patient must be able to eat and drink self

Anesthesia Points

- Total Intravenous Anesthesia (TIVA) using Propofol is used.
- Short-acting opioids like Fentanyl, Alfenatil is used
- Avoid Long-Acting Morphine to reduce Postoperative Nausea and Vomiting.

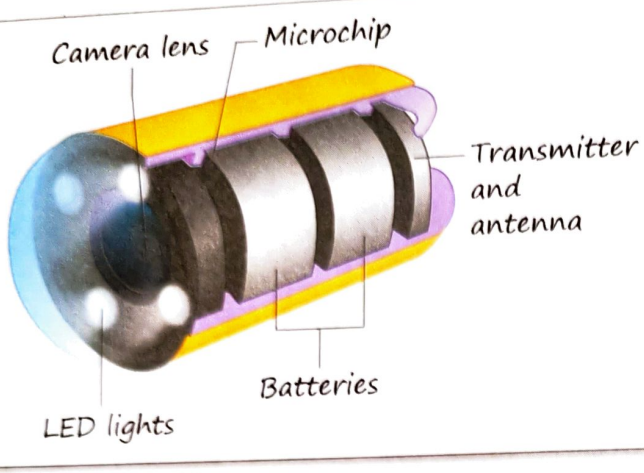
Discharge Criteria

- Vital signs stable >1 hour
- Oriented to place, time
- Oral analgesia relieves pain
- Able to dress and walk
- Minimal nausea, vomiting and dizziness
- Oral fluids taken
- Minimal bleed or discharge
- Passed urine
- Adult to take care for next 24 hours
- Knows when to come back
- Emergency contact number given

CAPSULE ENDOSCOPY

- 26 x 11 mm size capsule
- Battery life = 8 hours
- Total images 50000/8 hours
- Dummy capsule which can dissolve in 40 hours is used if you suspect chances of obstruction* or Strictures.

- Contraindications: Gastroparesis, pseudo obstruction, Strictures, Small bowel obstruction.
- Gold standard in Diagnosis of Occult GI bleeding and Crohn's disease"



Endoscopy

ERAS PROTOCOLS

- Early postoperative enteral feeding may decrease the incidence of infectious complications and is a component of most enhanced recovery after surgery (ERAS) protocols.
- The ERAS protocol describes the perioperative care pathway with recommendations for patient care at various steps in the perioperative process.

Points to be taken into consideration for ERAS protocols

- Preadmission counseling
- Avoid mechanical bowel preparation
- Preoperative carbohydrate loading
- No NG tubes
- Small transverse incisions or Laparoscopy surgery
- Avoid preoperative salt or fluid overload
- Short-acting anesthesia drugs
- Thoracic Epidurals
- Avoid opiate analgesia
- Maintain perioperative temperature
- Prevent postoperative nausea and vomiting
- Early mobilization
- Early introduction of oral fluids/ diets/ supplements
- Early removal of Foley catheter.

PRACTICE GUIDELINES ESTABLISHED BY THE ASA (AMERICAN SOCIETY OF ANESTHESIOLOGISTS) FOR PREOPERATIVE FASTING

Practice guidelines are methodically developed recommendations that help the health care professional and patient in making decisions about health care.
Some of the recommendations are as follows:

- **8 hours or more fasting** after intake of fried or fatty foods or meat
- **6 hours or more fasting** after ingestion of a light meal, nonhuman milk or infant formula.
- **The ASA recommends fasting at least 2 hours from clear liquid intake, including medicines"**. It helps to avoid symptoms of dehydration, hypoglycemia or caffeine withdrawal.
- Many fast-track protocols suggest a **"carbohydrate-rich drink 2 hours before surgery"** in order to convert the patient from the "fasted" to the "fed" state causing reduction in postoperative insulin resistance.

SURGICAL SITE INFECTIONS

Different types of surgeries with examples, infection rate with and without prophylaxis

Type of surgery	Examples of surgeries	Infection rate with prophylaxis	Infection rate without prophylaxis
Clean Surgery: (No viscus opened)	• Heart, Brain, Joint, Transplant surgeries • Herniorrhaphy* • Swelling excision	1%	1%
Clean Contaminated Surgery: (Viscus Opened, Minimal Spillage)	• Wound of Bowel, Biliary and Pancreatic Surgery • Uncomplicated appendicitis* • Gastro Jejunostomy	3%	5-10%
Contaminated surgery	• Appendiceal abscess • Perirectal abscess drainage • Infected laceration • Diverticulitis	6%	10-20%
Dirty Surgery	• Worst wound • Acute cholecystitis with spillage of pus from gallbladder. • Traumatic wound • Bowel obstruction with enterotomy and spillage of content.	7%	Upto 40%

Surgical site infection (SSI) is defined as:

- Wound Infection in <30 days of Surgery
- Wound Infection in <1 year of Implant cases
- Most common SSI pathogens are all gram-positive cocci—*Staphylococcus epidermidis*", S. aureus and *Enterococcus*"
- For infra inguinal incisions and intra cavitary surgery, gram-negative bacilli such as *Escherichia coli* and *Klebsiella* are potential pathogens.

How to prevent SSI?

- One hour before surgery prophylactic antibiotics (before incision)
- Shaving not advised now (If needed, skin clippers or epilators used to remove the hair just before shifting to OT)
- Avoid hyperglycemia during surgery (Blood sugar <200 mg/dL)
- Avoid hypothermia
- Avoid contamination (Sterile precautions)
- Avoid hypoxia intraop and post op also for 4 hours.
- Avoid hypotension
- Surgery Extending >4 hours (Every 4 hours one more dose is given)—Prophylactic antibiotics not given beyond 24 hours.

Grading Systems for SSI

Southampton Wound grading System: (Mnemonic- EISPA)

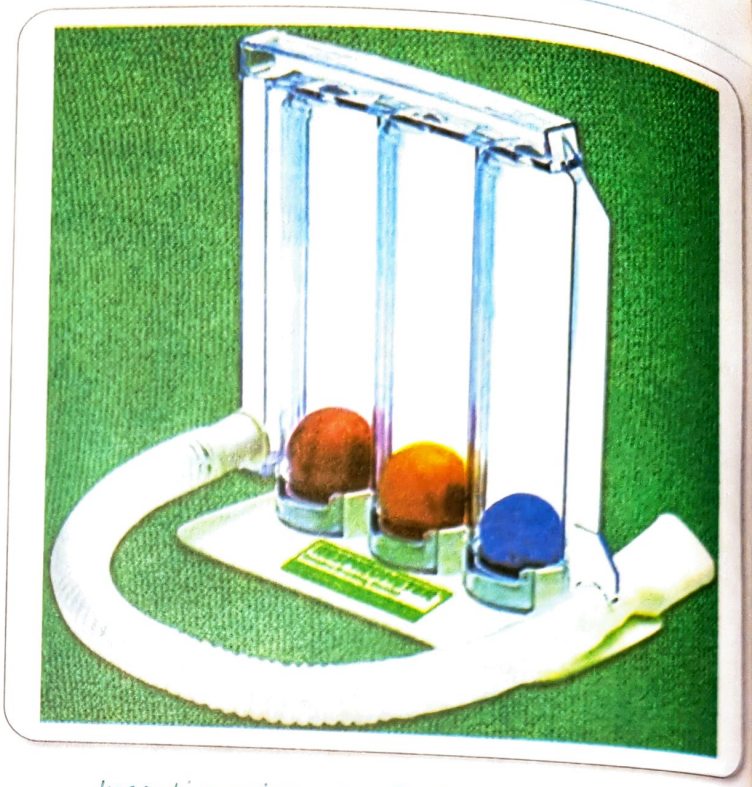
Grade	Appearance
0	Normal healing
1	Erythema
2	Inflammation
3	Serosanguinous discharge
Major Complications	
4	Pus
5	Anatomical separation

ASEPSIS Scoring System

	Criteria	Points
A	Additional treatment	0
	• Antibiotics for Wound Infection	10
	• Drainage of Pus under Local anesthesia	5
	• Debridement of Wound under GA	10
S	Serous Discharge	Daily 0-5
E	Erythema	Daily 0-5
P	Purulent Discharge	Daily 0-10
S	Separation of deep tissues	Daily 0-10
I	Isolation of bacteria from Wound	10
S	Stay as inpatient prolonged over 14 days	5

CAUSES OF POSTOPERATIVE FEVER

Day	Cause (Mnemonic—ABCDE)
1	Atelectasis of Lungs
2-3	Hospital Acquired Infection (MC UTI- Bladder infection) Atelectasis- Pneumonia Superficial Venous Thrombophlebitis (Catheters)
4-5	MC-Surgical Site Infection Deep Vein Thrombosis
6	Burst (Exposed) Abdomen in Laparotomy cases Salmon sign—Sudden gush of fluid is the 1st sign**
7 onward	Intra-abdominal Collection (MC in Pelvis/Morrison Pouch)



Incentive spirometer for breathing exercises

Pneumatic compression device to prevent DVT

SKIN LESIONS

Pressure Sores

- Tissue necrosis with prolonged pressure
- Also known as bed sores, pressure ulcers, decubitus ulcers.
- Incidence—5% in hospitalized patients.
- Pressure sore is MC in Ischium** > Greater Trochanter > Sacrum in the Gluteal region.
- After Gluteal region, the sites in order are- Heel> Lateral malleoli > Occipital region
- Pressure sore occurs if external pressure exceeds 30 mmHg of capillary occlusive pressure.
- **Prevention is the best treatment:**
  - Bedridden patients turned every 2 hours once
  - Wheel chair patients must lift themselves every 10 minutes for 10 seconds.

- **Treatment:**
  - Debridement
  - VAC devices at negative—125 mm Hg Suction pressure**
  - Flaps

Stage 3 Bedsore

Necrotizing Fasciitis

- Rapid progressive bacterial infection characterized by involvement and necrosis of the subcutaneous tissue and fascia, **with typical sparing of underlying muscle***
- MC site of Infection: **Lower extremity***
- May involve trunk, perineum (Fournier's gangrene), Abdominal wall (Meleney's gangrene), Head and Neck and any other site*
- MC single etiological agent—**Group A beta-Hemolytic Streptococci*** (Usually caused by Polymicrobial organisms)
- Risk factors—Diabetes, immunocompromised, smoking, penetrating trauma, obesity, IV drug abuse, skin infection (abrasions, bites and boils)
- **Pain is the MC presenting symptom*** and pain is disproportionately high.
- Wood hard texture in subcutaneous tissue*
- Systemic features—Fever, hypotension, tachycardia, progression to septic shock, DIC, MODS.
- **Treatment**—Urgent Surgical Debridement+ IV fluids+ Broad spectrum antibiotics+ Supportive treatment.
- Mortality is 100% without debridement*
- Hyperbaric Oxygen Therapy*

Fournier's gangrene

Hypertrophic Scar Versus Keloid

Differences between hypertrophic scar and keloid

Hypertrophic scar	Keloid
• Proliferation of mature fibroblasts*	• Proliferation of immature fibroblasts*
• No proliferation of blood vessels	• Proliferation of immature blood vessels
• Scars crossing Langer's lines	• Encroachment of surrounding tissues by claw like process
• Hypertrophy limited to the scar and does not encroach adjacent tissues	• Itching and blanching
• No claw like process	• Slightly warm and slightly tender
• No itching	• Most common in people with black or brown skin, has genetic association
• Equal in male and female	• Females > males
• Common in children	• Common age - 10-30 years
• Gradually regresses after 6 months	• Occasionally malignant change (Marjolin's ulcer)
• Does not recur after excision	• Recurrence after excision common
Common site: Flexor surfaces	• Intra keloidal – steroid, hyaluronidase, vitamin A and methotrexate to prevent recurrence.
	Common site: Sternum

Keloid

Trophic Ulcer

- Trophic ulcer is due to impaired nutrition, blood supply and added neurological deficit.
- Important causes: diabetes, tabes dorsalis, leprosy, peripheral neuritis, etc.
- Also called neurotrophic/neuropathic ulcer.

On examination:

- Painless ulcer
- MC location—pressure points like foot, back (bedsores) etc.
- Punched out
- Base formed by underlying bone

Trophic ulcer foot

Marjolin's Ulcer in a Burns Scar

Venous Ulcer: (Stasis Ulcer/Varicose Ulcer)

- **Site**: Lower 1/3 medial side of leg
- **Size**: Variable
- **Shape**: Oval to circular
- **Margin**: Well defined
- **Edge**: Sloping edge (healing)
- **Floor**: Formed by deep fascia
- **Surrounding**: Pigmentation, Eczema, varicosity (Lipodermatosclerosis)
- **Base**: Extend up to periosteum.
- **Deformity**: Talipes Equinovarus

Marjolin's Ulcer

- Ulcers due to burns, keloid or varicose ulcers can get converted to a malignancy known as Marjolin's ulcer
- Marjolin's ulcer is a squamous cell carcinoma.
- No lymph node mets seen.

SWELLINGS RELATED TO SKIN

1. Lipoma

- MC benign tumor in the body
- Universal tumor—occurs anywhere in body

Characteristic features:

- Nontender
- Semi fluctuant

- Mobile (slip sign)
- Skin is free

Complications:
- Sarcomatous change
- Saponification
- Calcification
- Submucosal lipoma in intestine causes intussusception and intestinal obstruction

Treatment:
Excision or enucleation

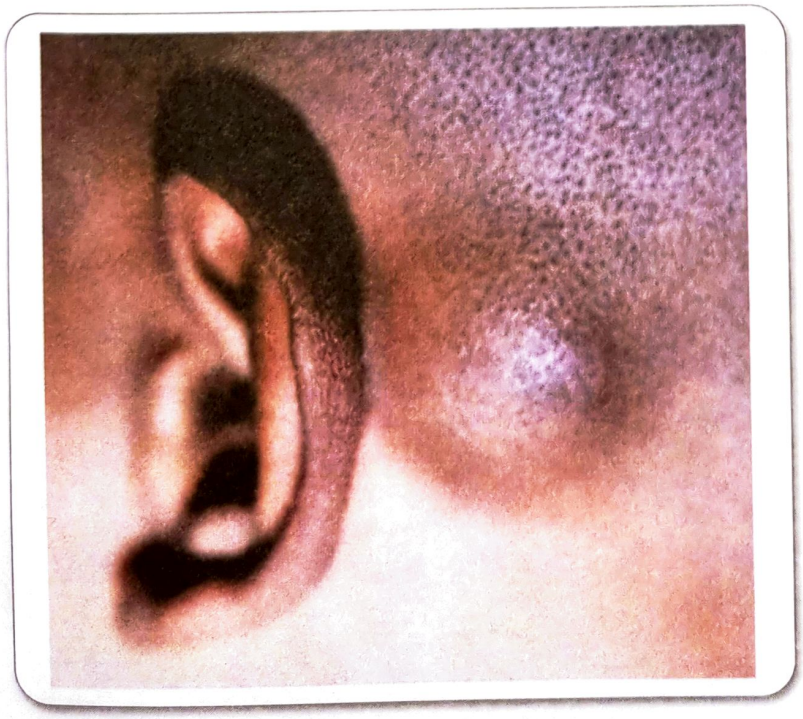
2. Dermoid Cyst

Four types

Sequestration dermoid

- Occurs at line of embryonic fusion
- Epithelium gets sequestrated
- **Clinical features:**
  - Free skin
  - Not transilluminant
  - Fluctuant
  - Indentation of bone

MC sites of sequestration:
- Forehead
- External angular dermoid
- Post auricular
- Root of nose
- Sublingual dermoid
- Anywhere in midline at fusion



Post auricular dermoid

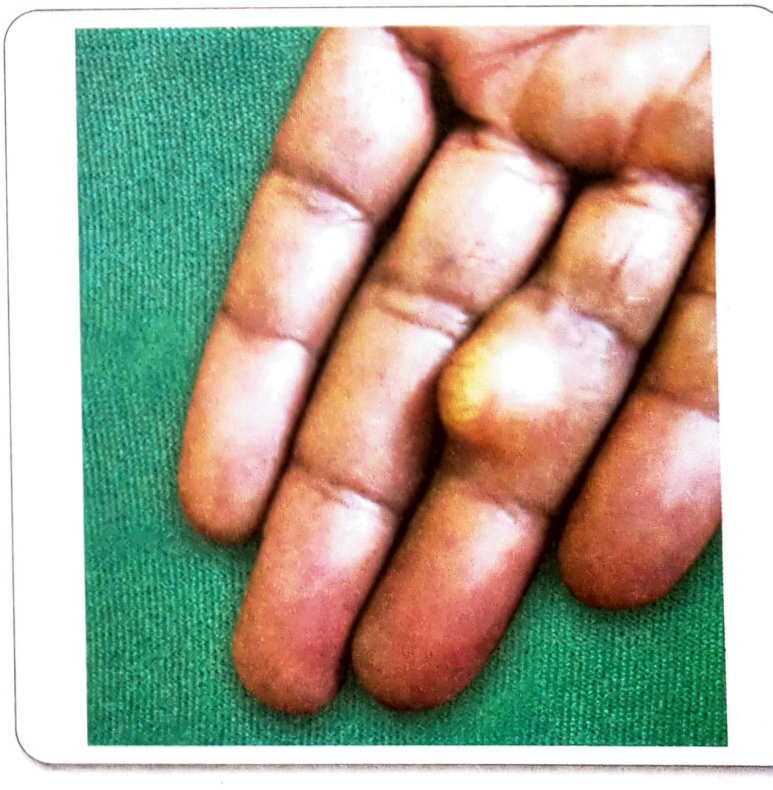
External angular dermoid

Tubulo Dermoid

Arises from embryonic structures
- Thyroglossal cyst
- Post anal dermoid

Implantation Dermoid

- Due to minor pricks or trauma, epithelium ge buried into deeper subcutaneous tissue.
- MC site is fingers



Implantation dermoid

Teratomatous Dermoid

- Arises from all germinal layers ecto, endo and mesoderm
- Occurs in ovary, testis, retroperitoneum and mediastinum.
- Contains hair, teeth, cartilage and muscle
- Can be benign or malignant.

3. Sebaceous Cyst

- Sebaceous cyst is a retention cyst due to blockage of the duct of sebaceous gland causing cystic swelling.
- Not seen in palms and soles

Characteristic features:

- Smooth, soft and nontender, mobile
- Molds on finger indentation
- Punctum – 70% cases (In 30% cases, the cyst opens into hair follicles and hence, punctum not seen)

Sebaceous cyst showing punctum

Extra Edge:

- **Cock's peculiar tumor:** Sebaceous cyst surface gets ulcerated leading to painful fungating mass in head.
- **Sebaceous horn:** Hardening of slow discharge sebum via the punctum.
- **Gardner syndrome:** Familial adenomatous polyposis associated with multiple sebaceous cysts.
- **Fordyce disease:** Ectopic sebaceous glands in lip and oral mucosa.
- **Dercum's disease:** Multiple painful lipomas (adiposis dolorosa).

Cock's peculiar tumor

HIDRADENITIS SUPPURATIVA

Chronic fibrous and infective disease of skin bearing apocrine sweat glands.

- Apocrine glands are those which open into hair follicle.
- MC in diabetics
- MC in axilla
- MC due to staphylococci
- Treatment: Excision with grafting.

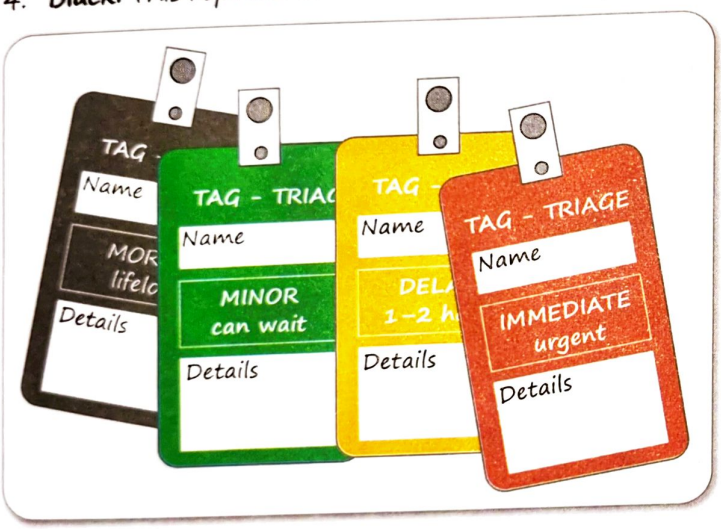
Hidradenitis suppurativa

TRIAGE

Triage, a French word, means "to sort"—Sorting out the injuries according to severity

Four color codes are given as follows:

1. **Red:** This represents first priority, i.e., a critical patient (e.g., Tension pneumothorax, pericardial tamponade).
2. **Yellow:** This represents second priority (e.g., Major bone fractures, open pneumothorax).
3. **Green:** This represents minor issues and third priority (e.g., Tibial fractures, wrist bone fractures).
4. **Black:** This represents dead or about to die patients.



PRIMARY SURVEY: cABCDE

- c – Catastrophic hemorrhage
- A – Airway
- B – Breathing
- C – Circulation
- D – Disability and neurological status
- E – Exposure

MC cause of airway obstruction is falling of tongue backward.

Airway maneuvers to prevent falling of tongue backward are:

- Jaw thrust
- Chin lift
- Guedel airway
- **Definitive airway:** Oropharyngeal, nasopharyngeal airway insertion, tracheostomy intubation.

Orotracheal intubation	Nasotracheal intubation
• MC done method • Contraindicated in maxillofacial injuries (more than one time we must not do)	• Contraindicated in: o Base of skull fractures o Cribriform plate fractures o CSF Rhinorrhea+ o Maxillofacial fractures

- Maxillofacial injuries—Tracheostomy intubation advised*

Management of Circulation

- Two large bore, short, peripheral IV catheters. (Minimum two 16 G Cannulas used).
- If peripheral veins are available—IJV central vein is used in trauma.
- Children <6 years—Intraosseous transfusion.
- **Permissive hypotension:** Target systemic pressure 70–90 mm Hg; It must not go very high to prevent rebleeding and must not go very low to prevent cerebral hypoxia.
- **CRASH-2 Trial:**
  - **Tranexamic acid:** 1 g IV Stat over 10 minutes followed by 1 g for 8 hours.
  - It should be given to all trauma patients suspected to have significant hemorrhage with PR >110/min or BP <90 mm Hg systolic.

Log Roll:

- Not done now as there is a delay in WBCT.
- Done by four people.
- Primarily meant for spine examination.
- Part of primary survey**.
- Along with spine examination, we can also do Anal wink reflex and PR examination.
- During PR—Vermooten sign to look for floating prostate in membranous urethra injury (contraindicated now).
- Log roll is absolutely contraindicated in pelvic fracture patients**.

DAMAGE CONTROL SURGERY (ABBREVIATED LAPAROTOMY)

Indications for Damage Control Surgery (DCS)

Deadly triad

- Hypothermia
- Acidosis
- Coagulopathy

Others:

- Serum Lactate >5 mmol/L
- ISS >36
- Systolic BP <70 mm Hg
- Transfusion >15 units of blood

Early Trauma Care (ETC)- Definitive management of Trauma Patient

Within 36 hours ETC if none of the above features seen

Serum Lactate – Significance:

- <2 mmol/L—ETC
- 2–5 mmol/L—Management in ICU
- >5 mmol/L—DCS

Damage control surgery is restricted to two goals only:

- Stop any active bleed
- Control any contamination.

Phases of damage control surgery:

- **Phase 1:** Initial exploration
- **Phase 2:** Secondary resuscitation
- **Phase 3:** Definitive operation

Phase 1 Initial exploration	Phase 2 Secondary resuscitation	Phase 3 Definitive treatment
• Control active hemorrhage and contamination* • Midline incision—4 quadrant packing done • GIT perforations closed with sutures or staples* • External drains kept for pancreatic/bile duct injuries • Temporary closure of abdomen using plastic sheet known as OPSITE** • Do Bogota bag method	• Transfer to ICU • Ventilatory support • Correct the deadly triad-hypothermia, acidosis, coagulopathy*	• Planned re-exploration and definite surgery* • Done 48–72 hours after secondary phase* • Complex reconstruction must be avoided* • Abdomen closure done in this phase only**

Stages of Damage Control Surgery as Per Bailey and Love

Stage	Procedure
I	Select the patient
II	Control hemorrhage, contamination
III	ICU resuscitation
IV	Definitive repairs
V	Closure of abdomen

HEAD INJURY

Methods to reduce intracranial pressure:

- Head up position 15°–30°
- Injections to reduce ICP—Mannitol (osmotic diuretics), Diuretics if BP is fine.
- Sedate the patient—Inj Barbiturates (Don't give diazepam as it can cause respiratory depression)
- Seizure prophylaxis—Sodium valproate
- Open skull fractures—prophylactic antibiotics
- Don't give steroids in trauma** (Can be used in malignancy in brain causing increased ICP)
- Lumbar puncture is contraindicated.
- External ventricular drainage is used to remove the CSF**
- Nasal oxygen

Glasgow Coma Scale (GCS)

Eye opening:
- Spontaneous – 4
- To loud voice – 3
- To pain stimuli – 2
- Do not open – 1

Verbal
- Normal oriented – 5
- Confused – 4
- Inappropriate words – 3
- Sounds only – 2
- No sounds – 1

Motor
- Obeys commands – 6
- Localizes to pain – 5
- Withdrawal flexion – 4
- Abnormal flexion – 3 (decorticate)
- Extension – 2 (decerebrate)
- No motor response – 1

Mnemonic:
- Verbal—One confused word sounds nowhere* (54321)
- Motor—Obey localities with flexion and extension now. (654321)

Essential points about GCS
- **Motor component – most predictive of future neurologic outcome**
- Maximum score = 15
- Minimum score (Dead patient) = 3
- Intubated patient = Mentioned as VNT (Not testable) = Score – 0
- Intubate when score is <8
- At admission when score is <13, take CT scan
- **Score represents the best performance elicited,** e.g., Flexion response to pain in left limb and localizing pain in right limb-take into consideration the best which is in right limb – M5**

Classification of head injury based on GCS:
- **Minor:** GCS 15 with no LOC
- **Mild:** GCS 14 or 15 with LOC
- **Moderate:** GCS 9–13
- **Severe:** GCS 3–8

Base of Skull Fractures

- **Raccoon/Panda eyes:** Bilateral periorbital hematoma (Anterior cranial fossa fractures)
- **Battle's sign:** Bruising over mastoid. Middle cranial fossa fracture
- **CSF otorrhea:** Middle cranial fossa fracture
- **CSF Rhinorrhea:** Anterior cranial fossa fracture
- Hemotympanum or bleeding from ear.

Battle sign*

Indications of NCCT Brain—NICE Guidelines: (National Institute for Health and Clinical Excellence)

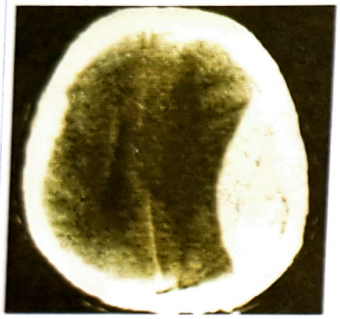
Indications of CT in 1 hour:

1. **GCS <13 at any point***
2. GCS <15 at 2 hours
3. Focal neurological deficit
4. Suspected open, depressed or base of skull fracture
5. Post trauma seizure
6. Vomiting > one episode.

Indications of CT within 8 hours:

1. Age >65
2. Coagulopathy (on warfarin, aspirin or Rivaroxaban)
3. Dangerous mechanism of injury
4. Retrograde amnesia (>30 minutes)

EDH

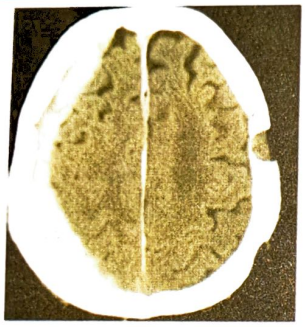


Biconvex appearance

- MC in young male patients
- Always associated with skull fracture
- Injured vessel—**Middle meningeal artery****
- MC site of injury is **temporal bone at pterion (thinnest part of skull)** which overlies the middle meningeal artery
- The hematoma is located between bone and dura mater.
- Lucid interval is seen - Period of consciousness before patient becomes unconscious

Treatment:
Burr hole is TOC
Mortality - 5%

SDH

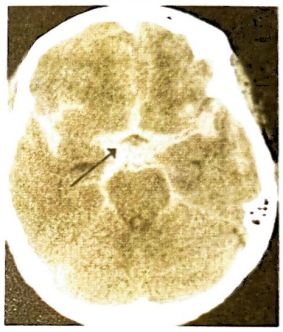


Concavo-Convex appearance

- Accumulates in space between dura and arachnoid
- Associated with bridging vein disruption and brain laceration*
- **C/F—Impaired consciousness from the time of impact itself.**
- **Acute SDH—Follows trauma**
- **Chronic SDH—People on Anticoagulants***

Treatment:
Acute SDH: Decompressive craniectomy and evacuation
Chronic SDH: Burr Hole
Mortality: 40%

SAH



MC type of hemorrhage - Intracerebral hemorrhage due to hypertension in PUTAMEN.
The picture shown above is subarachnoid hemorrhage with blood in subarachnoid cisterns

- MC cause of SAH nowadays is trauma
- Other cause is sudden rupture of berry aneurysm

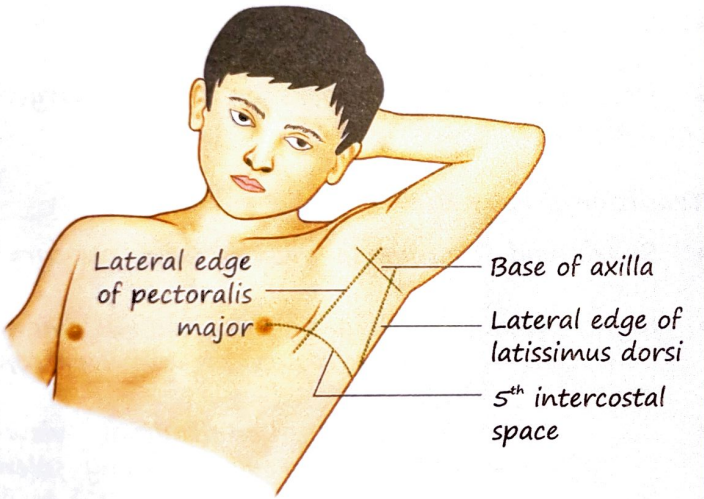
Diffuse Axonal Injury

- High acceleration and deceleration injury
- No surgery done
- Wait and watch
- IOC: MRI

THORACIC INJURIES

Intercostal Tube Placement: (ICD Placement)

- Pass the ICD in upper border of the rib (in lower border, intercostal vessels and nerve are present)
- **Triangle of Safety** – Anteriorly by lateral border of pectoralis major, posteriorly by mid axillary line and inferiorly by an imaginary horizontal line drawn at the level of nipple to meet mid axillary line.



Triangle of safety

- Best space is 5th ICS in midaxillary line.
- 28 Fr, 32 Fr tubes are used. Ensure all holes are inside the chest*
- Underwater drainage device provides **20 cm H_2O suction.****

How to say ICD is functioning well?

- Moving of the air liquid column in ICD tube in correspondence with respiration.

If the column is not moving, this implies:

- ICD is not in position
- ICD is blocked
- ICD is displaced and hole lies outside
- Lung has fully expanded

Indications of thoracotomy in thoracic injury:

- Hemothorax more than 1500 mL (Blunt trauma)
- Hemothorax more than 1000 mL (Penetrating trauma)
- Hourly collection in ICD of >200 mL/hr for 3 hours
- All the dangerous dozen injuries (Except pulmonary contusion, flail Chest)

Pericardial Tamponade

- MC mechanism – **Penetrating trauma****
- Collection of blood inside the pericardial cavity.
- Blood in pericardial cavity will compress the heart.
- **Beck's Triad:** Raised JVP, Low BP and Muffled Heart sounds*
- **X-ray shows Air Bag Appearance**
- **Differential Diagnosis: Tension pneumothorax (tachypnea with absent breath sounds seen)**
- **IOC: eFAST diagnosis**
- **Bailey 28th Edition Update—Needle thoracocentesis is no more advised, directly thoracotomy and repair are needed.**
- **MC complication of needle insertion—Arrhythmias***
- **Definite treatment**—Thoracotomy and repair of myocardial leak.

Tension Pneumothorax

- Mechanisms—Penetrating trauma, Blunt Trauma with rib injuring, Central vein insertion.
- Collection of Air between the parenchyma and pleura.
- Pleura is intact and hence, during every breath, air enters the pleural cavity and compresses the lung which is already compressed.
- This results in **mediastinal shift, absent breath sounds****, low BP and raised JVP. (DD: Pericardial tamponade)
- C/F—Tachypnea and Dyspnea
- **Lifesaving procedure**—5th ICS in midaxillary line in adults and 2nd ICS in children
- **Definite procedure**—ICD insertion.

Hemothorax

- **MC vessel injured—Intercostal artery**
- MC vessel injured in massive hemothorax—Internal Mammary artery bleeding or Internal thoracic vessels.
- 1st line treatment—ICD
- Immediately thoracotomy needed for >1500 mL (Blunt), >1000 mL (penetrating) and >200 mL/hr x 3 hours.

Flail Chest

- **Three or more ribs fractured in two or more places**"
- **Even one rib fractured at costochondral junction can cause flail chest.**
- Here, a segment of chest wall does not have continuity with the rest of thoracic cage.

Clinical features:

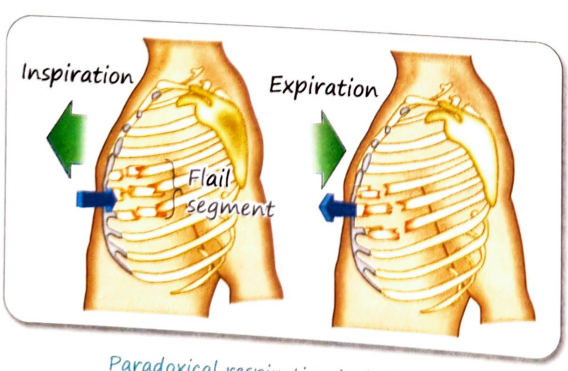
- On inspiration, **paradoxical movement** of chest occurs (segment moves inside on inspiration and on expiration that flail segment will move outside).
- Due to pain there is hypoxia.
- Underlying pulmonary contusion is the most important prognostic factor*.

Investigation of Choice:

- CT Scan with 3D reconstruction* to display vascular structures is the GOLD STANDARD IOC. It also shows the underlying lung parenchymal injury.

Management:

- Traditionally, the treatment is mechanical ventilation.
- But current treatment is only oxygen administration, adequate analgesia and physiotherapy.
- Mechanical ventilation is reserved for cases that develop respiratory failure, PaO_2 <60% and RR >18/min—Intermittent positive pressure ventilation (IPPV).
- Surgery and internal fixation of ribs are in use again.



Paradoxical respiration in flail chest

Diagnostic Peritoneal Lavage (DPL)

- Insert a cannula below the umbilicus.
- About 1000 mL of warm ringer lactate is instilled into the abdomen and is then drained out.
- DPL has sensitivity of about 97–98%.
- DPL is especially useful for hypotensive, unstable patients with multiple injuries as a means of excluding intra-abdominal bleeding.

Result: Positive

- >1 lakh red cells/microliter
- >500 white cells/microliter
- Frank aspiration of >10 mL on cannula insertion is also positive*
- >19 IU/L of amylase
- Presence of bile or food particles

Disadvantages

- Invasive
- Nonrepetitive
- So many false positive cases (Nontherapeutic laparotomies happened)

FOCUSED ASSESSMENT WITH SONOGRAPHY FOR TRAUMA (FAST)

- Latest eFAST (extended FAST) is done at 6 regions, previously done by 4 FAST
- Done by casualty doctors or trauma surgeon trained for FAST.

Traditional Four Views

- Subxiphoid **Transverse view**—assess pericardial fluid
- Right upper quadrant **Longitudinal view**—Collection in Morrison pouch or any liver/renal injuries
- Left upper quadrant **Longitudinal view**—Collection in perisplenic region or any splenic injuries
- Suprapubic **Longitudinal and transverse view**—Collection in pelvis; assess bladder and POD
- Added up now two extra areas—right and left thoracic views to rule out pneumothorax (Stratosphere sign) or hemothorax.

Advantages of eFAST

- Repetitive
- Noninvasive
- Bedside investigation
- Short time study

Disadvantages of eFAST

- Detects more than **100 mL blood only**" (Bailey value)
- Does not detect bowel injury
- Not useful for penetrating injury (NEET PG 2020)
- Unreliable for RP collections
- Operator dependent.

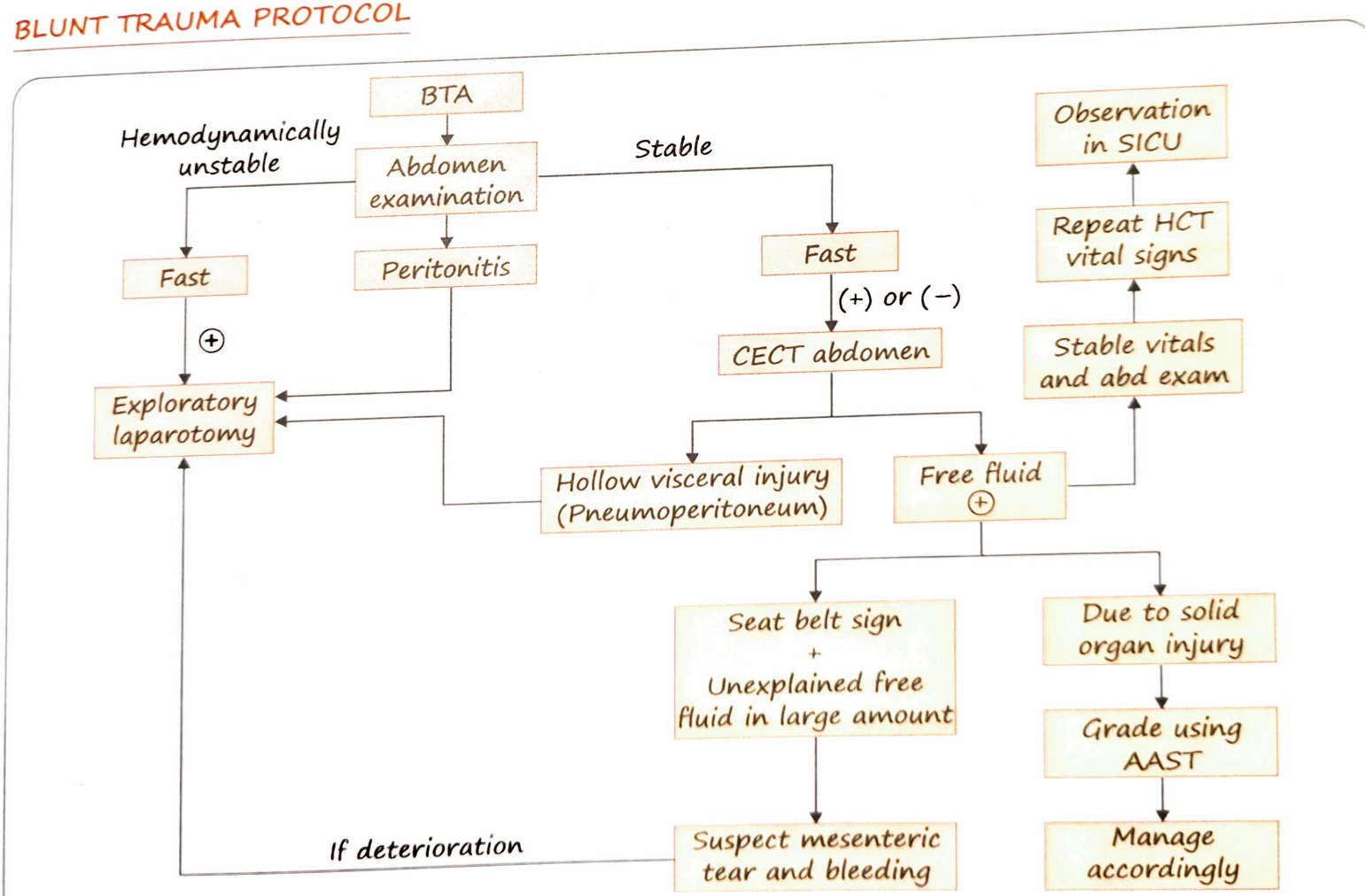
IOC for unstable patients: eFAST
IOC for stable patients: CECT abdomen

Sequence Order Question

Blunt trauma	Penetrating trauma	Gun shot	Seat belt injuries
• Spleen • Liver • Small Intestine	• Liver • Stomach • Small bowel • Diaphragm • Colon	• Small bowel • Colon	• MC injury is mesenteric tear • In GIT—DJ flexure is injured

- Urban bomb blast—Ear drum > Lungs
- Underwater bomb blast—GIT (MC in terminal Ileum)

BLUNT TRAUMA PROTOCOL

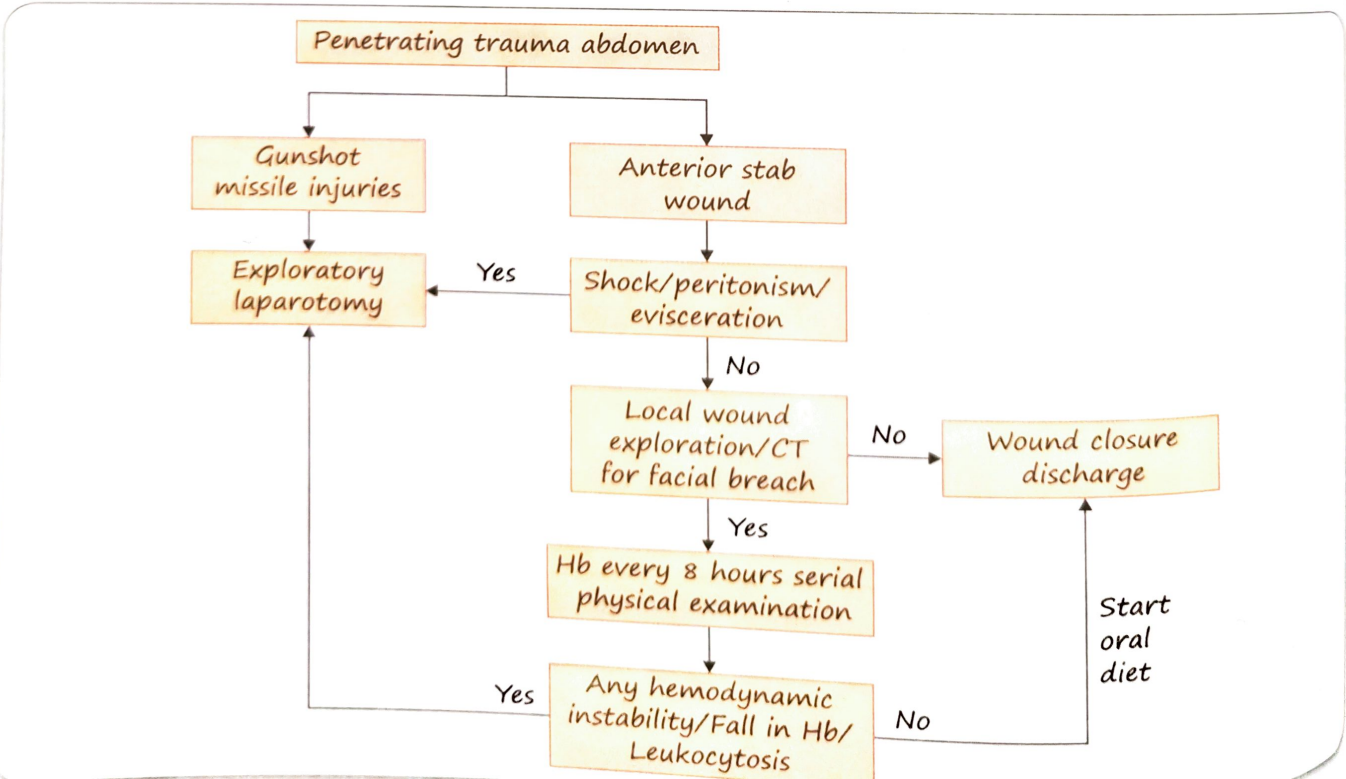


SOLID ORGAN INJURY-AAST GRADING

American Association for the Surgery of Trauma grading scales for solid organ injuries

	Subcapsular hematoma	Laceration
Liver Injury Grade		
Grade I	<10% of surface area	<1 cm in depth
Grade II	10–50% of surface area	1–3 cm
Grade III	>50% of surface area or >10 cm in depth	>3 cm
Grade IV	25–75% of a hepatic lobe	
Grade V	>75% of a hepatic lobe	
Grade VI	Hepatic avulsion	
Splenic Injury Grade		
Grade I	<10% of surface area	<1 cm in depth
Grade II	10–50% of surface area	1–3 cm
Grade III	>50% of surface area or >10 cm in depth	>3 cm
Grade IV	>25% devascularization	Hilum
Grade V	Shattered spleen	
	Complete devascularization	

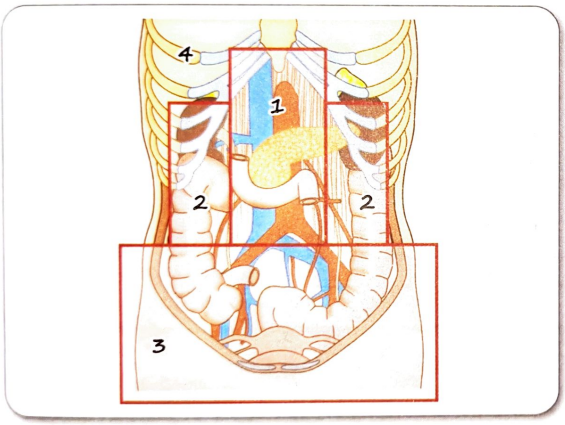
PROTOCOL FOR PENETRATING INJURY



RETROPERITONEAL HEMATOMA

In retroperitoneum, four zones are explained; and management differs based on the hematoma in each zone.

Zones	Contents	Management
Zone I	Central vascular structures such as aorta and IVC	Needs exploration
Zone II	Kidneys and adrenal glands	Observed
Zone III	Retroperitoneum associated with pelvic vasculature	External pelvic compression and fixation
Zone IV	Retrohepatic IVC and hematoma behind portal vein	Observation



Zones of retroperitoneal hematoma

- **Mattox Maneuver:** Left side medial visceral rotation to reach aorta.
- **Cattell-Braasch Maneuver:** Right side medial visceral rotation to reach IVC.

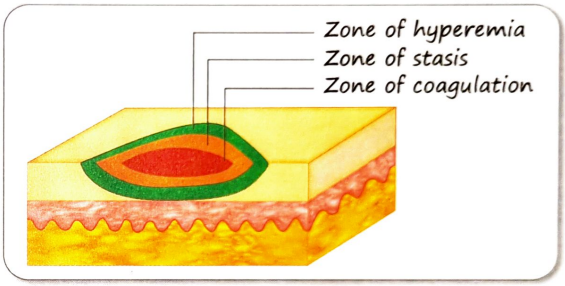
THERMAL INJURIES

MC cause of death in burns:

- **On the spot (Immediate death):** Asphyxia >Neurogenic shock
- **1–3 days (Early death):** Hypovolemic shock
- **Late death:** Septic shock
- **MC cause of death in burns overall:** Septic shock

If percentage of burns is more than 15% in Adults and 10% in Children, it can develop in hypovolemic shock.

PATHOPHYSIOLOGY OF BURNS



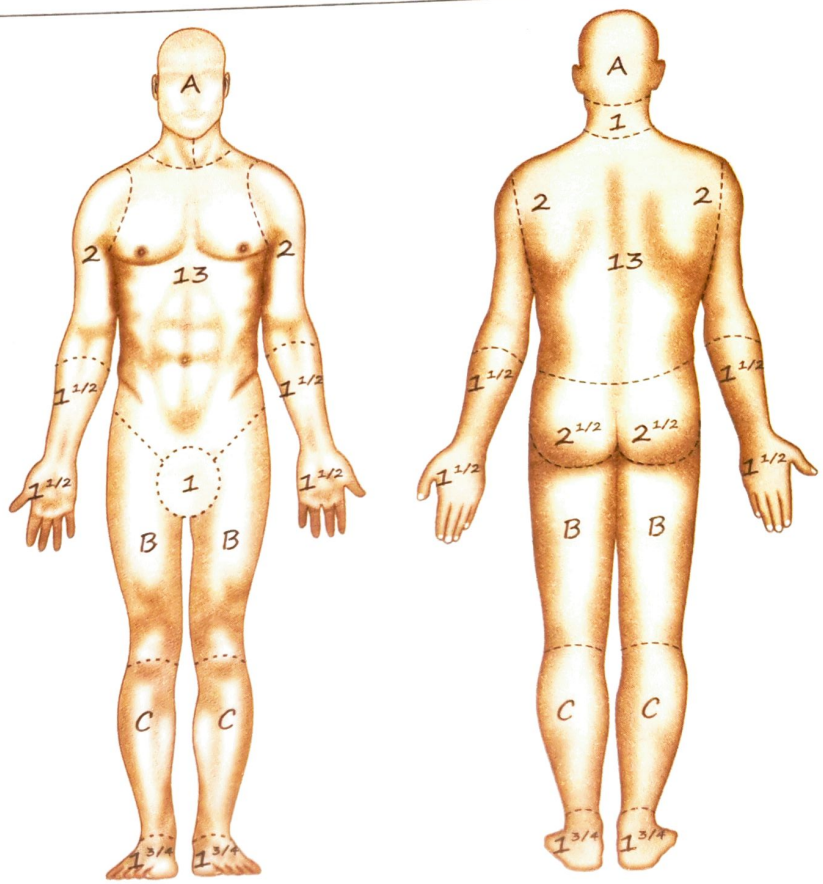
- **Zone of coagulation:** Irreversible damage
- **Zone of stasis:** Can progress or regress
- **Zone of hyperemia:** reversible zone** —Vessels are vasodilated here.

PERCENTAGE OF BURNS CALCULATION

Rule of nine (Alexander Wallace rule)

- Each upper limb—9% TBSA
- Each lower leg—18% TBSA
- Anterior or Posterior Trunk—18% TBSA
- Head and neck—9% TBSA
- Perineum—1% TBSA

Palm rule: Patient's palm = 1%



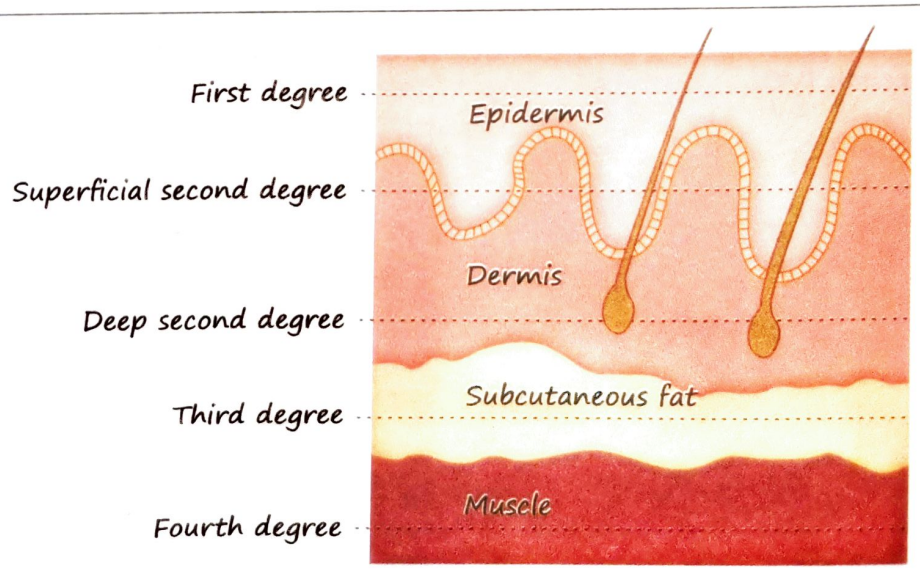
Relative percentage of area affected by growth

Age in years	0	1	5	10	15	Adult
A head	9	8	6	5	4	3
B thigh	2	3	4	4	4	4
C leg	2	2	3	3	3	3

Lund and Browder chart

- Most accurate method for calculating the burns percentage**
- Best method to calculate burns in children.

DEPTH OF BURNS



First-degree of burns: Superficial burns:

- Erythema + pain
- Heals without scar in 7 days
- Blanches on pressure

Second-degree superficial (Superficial partial thickness burns)

- Characterized by Blisters.
- Superficial touch (Cotton) – Sensation +
- Pin Prick – Sensation +
- Heals without scar in 3 weeks
- Blanches on pressure

Second-degree deep (Deep partial thickness burns)

- Characterized by Blisters
- Superficial touch (Cotton)—Sensation Absent**
- Pin Prick – Sensation+
- Heals with scar in 5 weeks
- No Blanching on pressure

Third-degree (Full thickness burns)

- Eschar formation seen
- Painless burns.
- Superficial touch (Cotton)—Sensation Absent**
- Pin Prick—Sensation absent**
- Can result in contracture and compartment syndrome

Fourth-degree burns

- Involving deep muscles and tendons**
- Most of them die due to cardiac arrest.

Management

- IV fluid of choice—Ringer lactate*
- Amount of fluid to be infused is calculated by **Parkland formula:**
- **TBSA% × weight (kg) × 4 = volume (mL) needed**
- Half of this volume is given in the first 8 hours, and the second half is given in the subsequent 16 hours.
- **This formula is calculated from time of BURNS** (Not from the admission)**
- In the initial 12 hours, we must give crystalloids only and not colloids as they may have leaking capillaries, which will lead to subcutaneous edema due to the colloids entering the subcutaneous space.
- **>12 hours Colloids like Dextran, hemacel, albumin are given based on "MUIR and BARCLAY Formula".**

Management of Burns Wound

First- and Second-Degree Superficial Burns

- Topical ointments
- MC used—Silver sulfadiazine (Cannot penetrate deeper tissues like Eschar)
- Silver nitrate (Black staining may happen)
- Mafenide Acetate—Can penetrate deeper into eschar (Can cause Metabolic acidosis**)
- Best of all agents—Cerium Bromide (Immunomodulator)—Costly
- SSD+ Cerium Bromide makes the eschar sterile and stimulates cell mediated immunity
- Collagen sheets are available in 2nd degree superficial burns.

Second-Degree Deep Burns

SSG (Thiersch graft is used)—Taken by Humby knife.

Third-Degree Burns

- SSG
- Escharotomy is done to avoid compartment syndrome.

ORAL CAVITY AND MALIGNANCY

Conditions Associated with Malignant Transformation

High-risk lesions
- Erythroplakia
- Speckled erythroplakia
- Chronic hyperplastic candidiasis

Medium-risk lesions
- Oral submucous fibrosis
- Syphilitic glossitis
- Sideropenic dysphagia (Paterson—Kelly syndrome)

Low-risk/equivocal-risk lesions
- Oral lichen planus
- Discoid lupus erythematosus
- Discoid keratosis congenita

Leukoplakia

- White patch or plaque involving wide areas of oral mucosa
- 2.4% malignant transformation at 10 years, 4% at 20 years
- Speckled leukoplakia has the highest rate of Malignant transformation**
- Incidence among smokers: 20%; Nonsmokers: 1%
- Can be managed conservatively: Avoid smoking, carbon dioxide laser excision.

Leukoplakia

Erythroplakia

- Bright red velvety plaques of oral mucosa.
- Has 17 times more malignant potential.

Erythroplakia

Must know:
- MC site of Oral cancer in World/Western countries—Tongue > Lip
- MC site of Oral cancer in India—Buccal Mucosa > tongue
- Histological type commonly seen in Oral cancers—Squamous cell cancer
- MC site of cancer to produce LN mets—Tongue
- Skip Mets are common with—Tongue cancer
- Bilateral LN spread seen in Lower lip, Supraglottis and Soft palate
- IOC for staging Oral and Parotid cancers—MRI
- Staining used to identify areas of Cancer in oral cavity—2% Toluidine blue

TNM Staging of Oral Cancers: (AJCC 8th Edition Update)

Annexure 1: AJCC 8th Edition Oral Cancer Staging

T staging:
- Tis—Carcinoma in situ
- T1—Tumor in greatest dimension <2 cm and DOI <5mm
- T2—Tumor <2 cm and DOI >5 mm but <10 mm or Tumor >2 cm but <4 cm and DOI <10 mm
- T3—Tumor more than 4 cm or any size with DOI >10 mm
- T4 a—Invasion into adjacent structures like cortical bone, inferior alveolar nerve, floor of mouth or skin of nose and chin in lip cancer and skin of face in oral cancer.
- T4 b—Invasion into masticator space, pterygoid plates, carotid sheath or encases internal carotid artery
- **Extrinsic muscle invasion is not considered T4 nowadays**

Contd...

N staging:

- N1—Metastasis in **single node ≤3 cm** in greatest dimension with no Extra nodal Extension (ENE—Negative)
- N2a—Metastasis in **single node** greater than 3 cm but not larger than 6 cm in greatest dimension, **(>3 cm to ≤6 cm)** No Extra nodal Extension (ENE—Negative)
- N2b—Metastasis in Multiple **Ipsilateral** nodes, **none larger than 6 cm**. ENE Negative.
- N2c—Metastasis in Bilateral or **Contralateral** nodes, **none larger than 6 cm**, ENE Negative.
- N3a—Metastasis in a Lymph node larger than 6 cm in greatest dimension, ENE Negative
- **N3b—Metastasis in any size node with ENE+ve (Newly added point in AJCC)****

M staging:

- M1—Metastasis +

Investigations in Oral Cancers

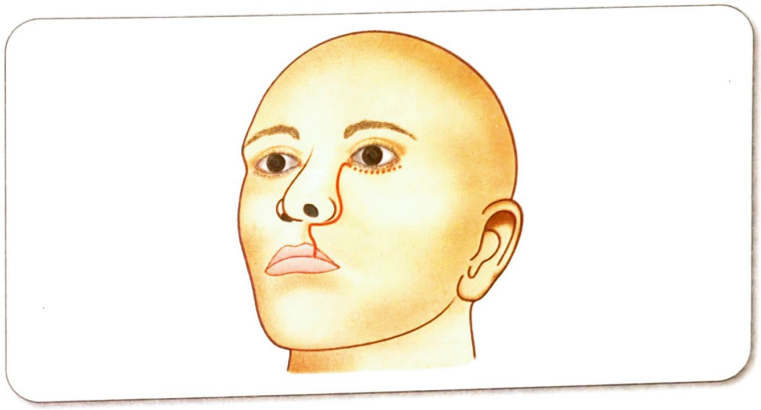
- Biopsy: Incisional biopsy under local anesthesia* Biopsy must include normal area also*
- MRI is the IOC for oral, oropharyngeal, neck cancers. Ideally it should be performed before biopsy**
  (STIR—Short Tau Inversion Recovery MRI-Contrast enhanced with Gadolinium and Suppression techniques and variation in image sequence acquisition)
- CT is useful in diagnosing Bone invasions**. CT thorax is now mandatory for all Oral cancers to look for mets.
- PET CT is helpful in patients managed by nonsurgical method of oropharyngeal cancer. It also helps in diagnosing recurrence.
- USG guided FNAC of the neck nodes using 21 or 23G needle and there is no risk of dissemination.

Reconstruction of Tongue after Glossectomy

- **RFFF (Radial Forearm Free Flap)**
  - Most commonly used
  - Based on radial artery.
- **PMMC flap (Pectoralis Major Myocutaneous flap)**
  - Based on thoracoacromial artery
  - In females—Can lead to Ca breast
- **Delto pectoral flap (DP flap)**
  - Can be used in females
  - Based on internal mammary artery.

Carcinoma Hard Palate and Maxillary Alveolus

- Smaller tumors—Transoral Partial Maxillectomy
- Larger tumors—Weber Ferguson Incision is used for a wider excision involving the maxillary floor.



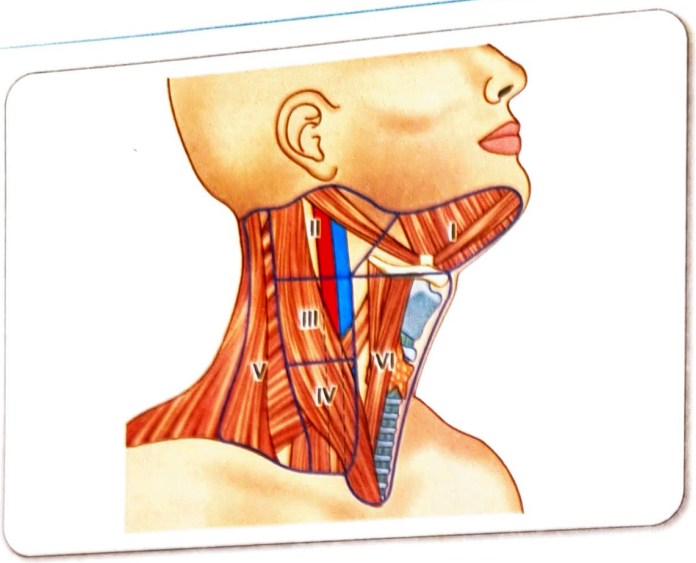
Weber Ferguson Incision for Hard palate tumors

Nodal Dissection in Neck

Level of Nodes

There are 7 levels in neck.

1.	Submental and Submandibular nodes	
2.	Upper Jugular	Extend from base of skull to hyoid bone
3.	Middle Jugular	Extend from hyoid bone to cricoid cartilage
4.	Lower Jugular	Extend from cricoid cartilage to suprasternal notch
5.	Supraclavicular or Posterior Group	
6.	Prelaryngeal/ Pretracheal (Schwartz says-prelaryngeal as Delphian nodes)	Extend from hyoid bone to sternal notch
7.	Upper mediastinal nodes	



Level of nodes in neck

Radical neck node dissection

Types of Neck Dissection

Academy Classification of Neck Dissections

a. Radical neck dissection by CRILE.
b. Modified radical neck dissection by BOCCA
   - Type I—Preserves spinal accessory nerve
   - Type II—Preserves spinal accessory and internal jugular vein
   - Type III—Preserves spinal accessory nerve, IJV and SCM
c. **Selective Neck Dissection**
   - Supra omohyoid neck dissection Level I, II, III—Lip and oral cavity
   - Lateral neck dissection level II, III, IV—Larynx
   - Posterolateral neck dissection level II, III, IV, V—Thyroid

1. **Classic radical neck dissection (CRILE'S Operation)**
   Structures Removed:
   - Lymph nodes (level I-V), fat, fascia, sternomastoid, strap muscles, internal jugular vein and accessory nerve, submandibular salivary gland; lower part of parotid en bloc.

   Structures preserved:
   - Carotid artery (you can sacrifice branches of external carotid artery), Vagus nerve, Lingual nerve, Hypoglossal nerve, phrenic nerve, cervical branch of facial nerve.

2. **Modified radical neck dissection of Bocca (MRND)**
   - Level 1- 5 nodes are removed**
   - Structures removed are same as Radical neck dissection except for the following are preserved spinal accessory nerve, internal jugular vein and sternocleidomastoid muscle (functional block dissection)**

SALIVARY GLAND

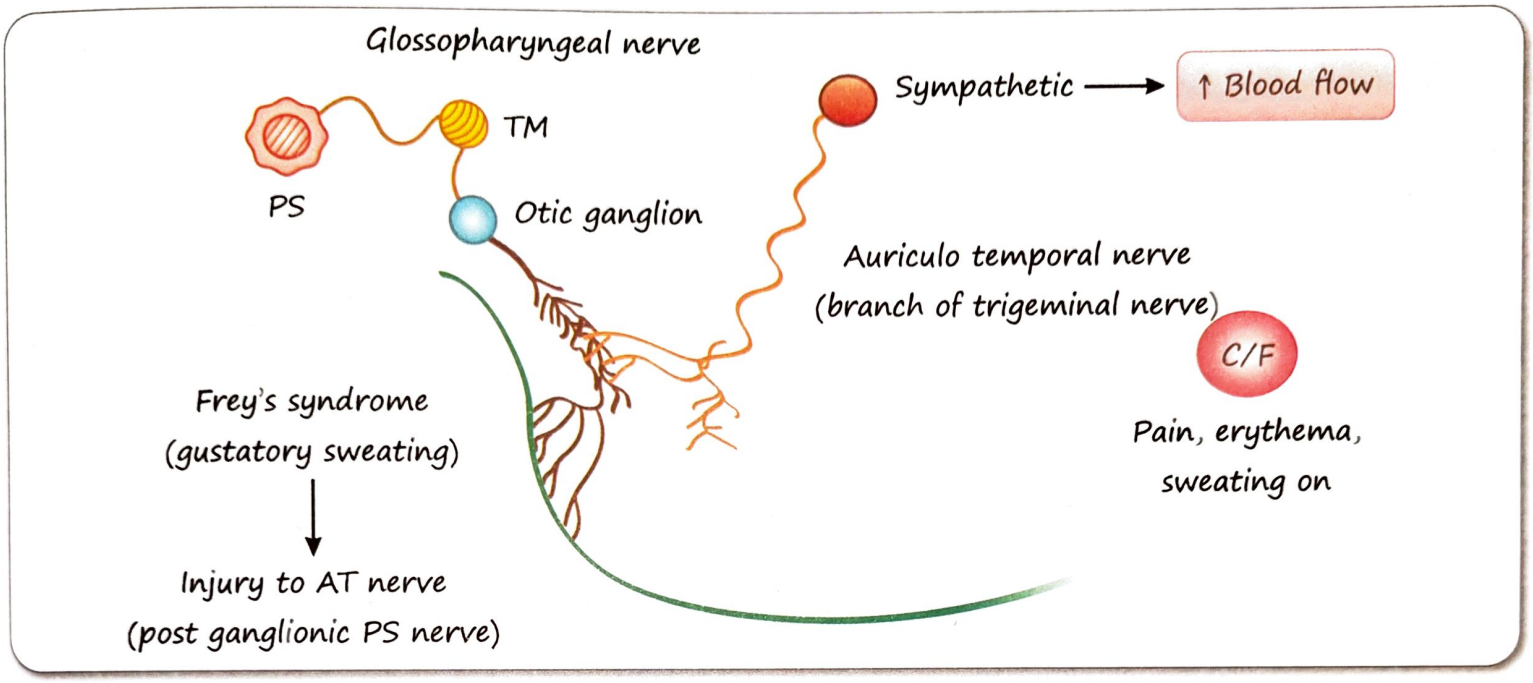
Facial Nerve Trunk Identification During Parotidectomy

- **Conley's pointer (tragal pointer)****
  - Junction of bony and cartilaginous EAC - points downward 1 cm inferior
- Posterior belly of digastric insertion (above this)
- Stylomastoid foramen
- Facial nerve monitors

Nerve Supply of Parotid

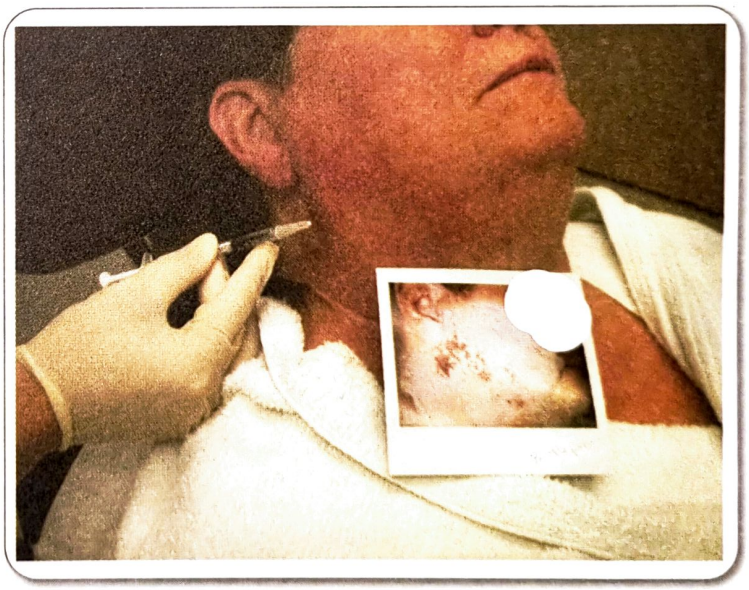
1. **Parasympathetic**
   - Salivary nucleus—Via glossopharyngeal nerve (crossing Tympanic membrane)—Relay in Otic ganglion—Postganglionic fibers via auriculotemporal nerve (branch of trigeminal nerve) supply parotid
   - Leads to increased salivary secretion
   - Serous discharge

2. **Sympathetic supply**
   - Increase blood flow to gland



Frey's Syndrome (Gustatory Sweating Syndrome)

- Injury to Auriculotemporal nerve (post ganglionic parasympathetic nerve injury)
- Sympathetic fibers overgrow, join with auriculotemporal nerve and reach skin
- C/F—Pain, erythema and sweating over face on just seeing food
- Presents—2-3 months after parotidectomy operation
- Prevented by interposition of flaps between skin and operative area.
  - Sternomastoid muscle flap
  - Temporalis muscle flap
- **IOC: Starch iodine test**
- **Treatment**—Latest Botox injection at areas of reinnervation appearing as Erythema on Starch Iodine test.



Starch Iodine test

Tumors in Salivary Gland

	Benign	Malignant
Parotid	80%	20%
Submandibular	50%	50%
Minor Glands	10%	90%

As the gland becomes smaller, malignancy increases.

Types of Epithelial Tumors

Benign

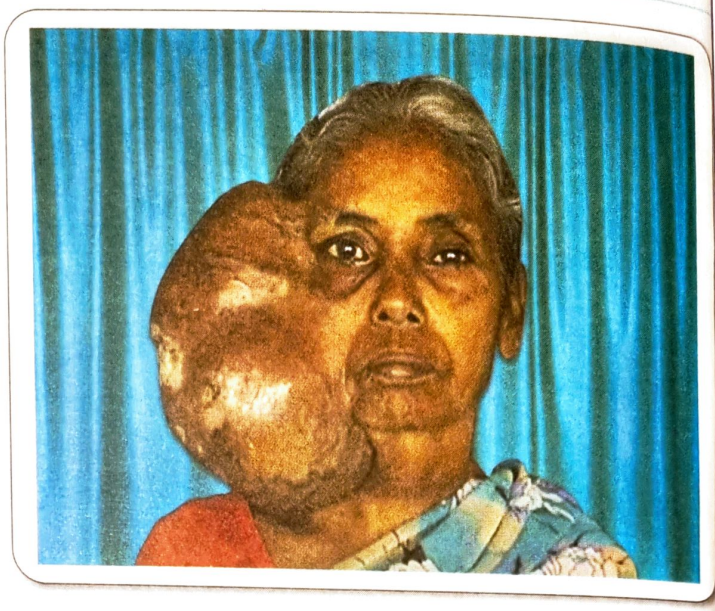
- Pleomorphic adenoma
- Warthin's tumor

Malignant

- Mucoepidermoid
- Adenoid cystic
- Acinic cell tumor

Differences between Pleomorphic adenoma and Warthin's tumor

Pleomorphic adenoma	Warthin's tumor
Also called mixed tumor (As it has both epithelial and mesenchymal tissue)	Also called adenolymphoma
MC benign tumor of parotid, submandibular gland and minor salivary glands	**Exclusive for Parotid gland****
Seen in tail of parotid	**Lower pole of parotid****
Three classical features 1. Lift the ear lobule 2. Curtain sign positive 3. Obliteration of retromandibular groove	–
Bi digitally palpable +	–
Tonsil pushed medially (if deep lobe is enlarged)	–
Pathology: • Rarely capsule+ – not well defined capsule • Pseudopod extension into normal gland	Well defined capsule
Only Parotidectomy is TOC	Enucleation or parotidectomy
C/F: All salivary gland tumors are most common in females.	Old male (5^{th}–7^{th} decade)



Huge Pleomorphic adenoma

Extra Edge – Warthins Tumor:

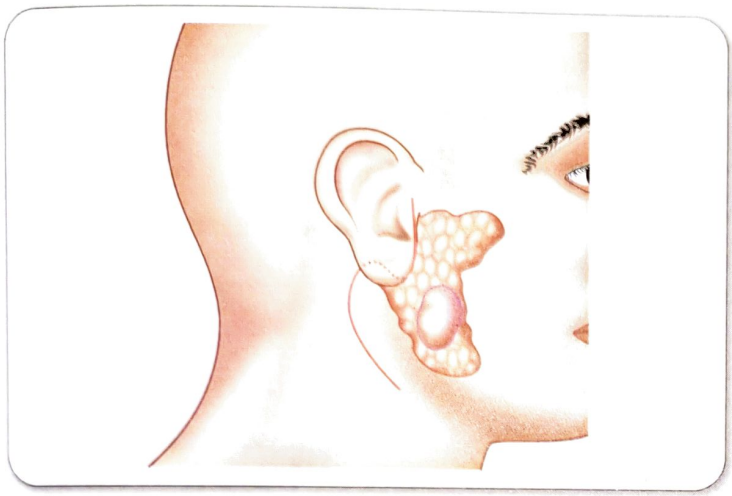
- Malignant transformation is rare (never occurs)
- Occurs exclusively in Parotid.
- MC site is lower pole* (Pleomorphic adenoma at Tail of Parotid)
- Multicentric/bilateral occurrence is more common
- MC occurs in lower pole (at angle of mandible)
- MC in smokers
- MC in males (5^{th} to 7^{th} decade)
- Hot spot in technetium 99m scan

Differences between mucoepidermoid cancer and adenoid cystic cancer

Mucoepidermoid cancer	Adenoid cystic cancer also known as cylindroma
High or low grade variants	High or low grade variants
MC malignant tumor of parotid	• MC malignant tumor of submandibular gland • Perineural infiltration + • Base of skull extension
30% LN enlargement (Increased LN mets)	No LN mets

Surgical Aspects

Sistrunk Incision—Lazy S Shaped Incision done for Parotidectomy



Sistrunk incision for parotidectomy

- **Simple parotidectomy:**
  - Only superficial lobe removed
  - Deep lobe and facial nerve preserved
  - Done in benign tumors
- **Total conservative parotidectomy:**
  - Superficial + deep lobe removed
  - Facial nerve is preserved
  - Done in deep lobe benign tumors
- **Radical parotidectomy:**
  - Superficial + deep lobe + facial nerve removed
  - Done in malignant
    - Mucoepidermoid
    - Adenoid cystic tumor

Total conservative parotidectomy

Postop Complications

Nerve Injuries

- MC nerve injured—**Any branch of facial nerve**
  - Bell's phenomenon
  - Deviation of mouth
  - Loss of nasolabial fold
- MC cutaneous nerve injured—**Greater auricular nerve****
  - Paresthesia in shaving area
- Auriculotemporal nerve (postganglionic parasympathetic injury)—**Frey's syndrome**

Extra mile

Parotid surgery:

- While doing parotid surgery—if a branch is adherent the tumor, it must be resected.
- The resected nerve can be reconstructed using Greater auricular nerve.
- All nerve branches compromised can be reconstructed except the Buccal branch**

High Yield Facts:

Ranula

- Mucous extravasation** cyst arising from sublingual gland
- Latin word Rana means—Frog's Belly**
- Develop on floor of mouth.
- Surgical management: Excision of cyst and affected gland.
- Incision and drainage result in Recurrence.

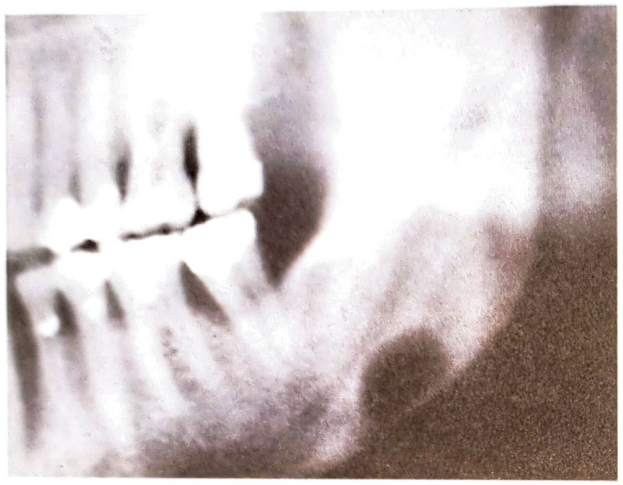
Ranula

Plunging ranula:

- Mucous retention cyst** that can arise from both sublingual salivary glands.
- Mucous collects around the gland and penetrates the mylohyoid diaphragm to enter the neck.

Stafne Bone Cyst

- Most common site of ectopic salivary tissue*
- Located below inferior dental neurovascular bundle (at angle of mandible – radiolucent area)
- No treatment needed



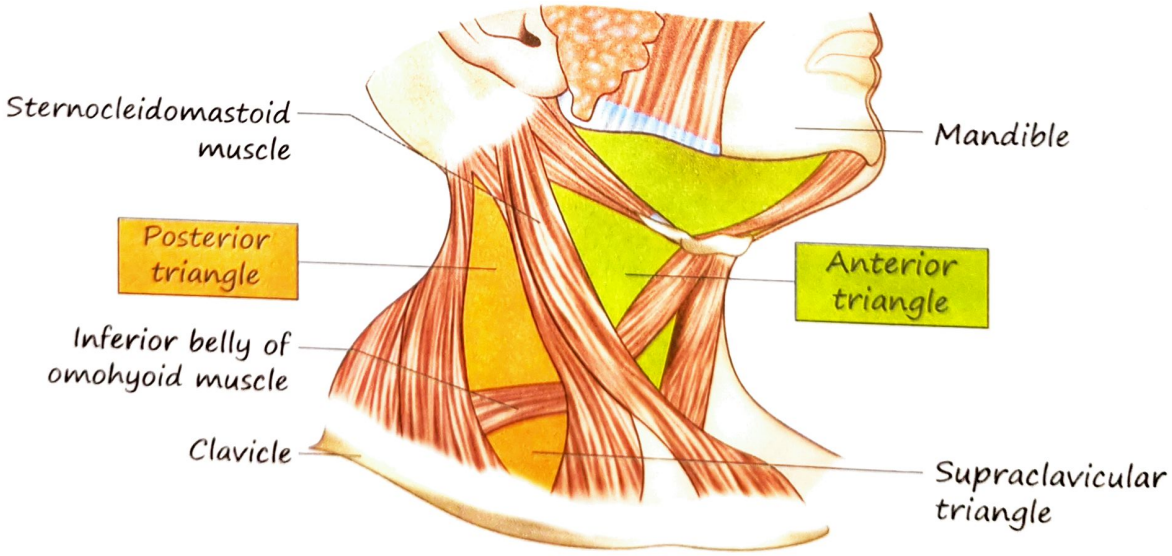
Stafne bone cyst

Obstruction of Submandibular Duct

- MC cause of obstruction is stone (sialolithiasis), 2nd MC cause is Stricture**
- 80% stones are radiopaque.
- Painful swelling occurs in Submandibular region- appears rapidly after meals and disappears in 1–2 hours*—Meal-time Syndrome** (if the obstruction by stone is complete usually at the opening of Submandibular duct)
- Small, less than 4 mm, mobile stones can be retrieved using a Dormia basket**
- Larger stones can be broken by Lithotripsy and can be removed with a basket**
- Recently – Pneumatic Intraductal Lithotripter is used.

SWELLINGS IN THE NECK

Anatomy of Triangles of Neck



Neck triangles

The triangles you must know are as follows:

- Anterior triangle:
  - Carotid triangle
  - Digastric triangle
  - Submental triangle
  - Muscular triangle (More in midline)
- Posterior triangle:
  - Supraclavicular triangle
  - Suboccipital triangle

Differences between carotid triangle and posterior triangle

	Carotid triangle	Posterior triangle
Solid type	Carotid body tumor	Cervical rib
Liquid type	Branchial cyst	Cystic hygroma
Air filled swelling	Laryngocele	Pharyngeal pouch (Zenker's diverticulum)

Carotid Body Tumor (Potato Tumor/ Paragangliomas/Chemodectoma)

Pathology

- Histologically—Non chromaffin paraganglioma
- Associated with pheochromocytoma**
- Usually unilateral; MC in 5th decade, MC in women
- 10% have family history
- MC in high altitudes and due to Hypoxia*
- Incidence is 0.5%

Must know:
Carotid body tumors arise from chemoreceptor cells (not baroreceptor cells) of carotid body and are stimulated by decreased arterial oxygen tension, e.g., Cyanotic heart disease, chronic hypoxia in high altitude inhabitants**.

Clinical Features

- 75% cases present with neck mass (Slow growing firm mass)
- Mobile side to side—But not vertically (FONTAINE SIGN)**
- Pulsatile but not expansible*
- Malignancy seen in 5–10% cases
- Rarely metastasize

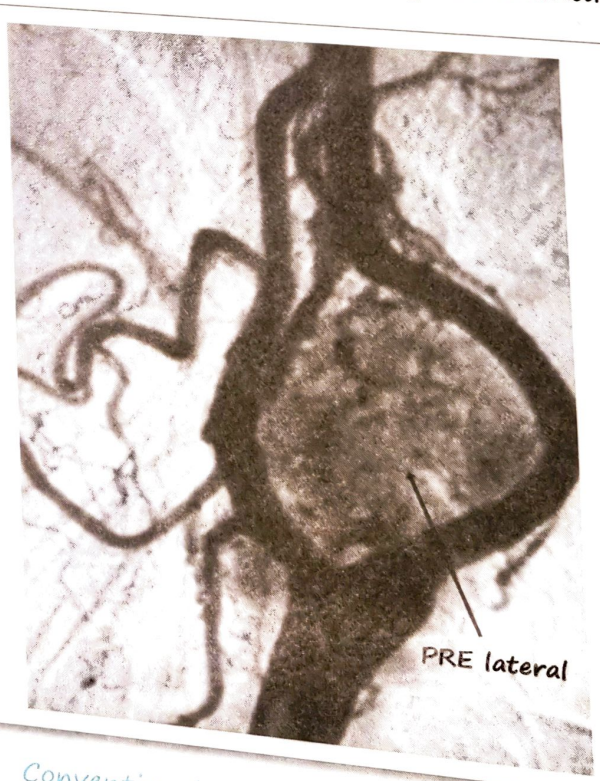
Carotid body tumor

Investigations

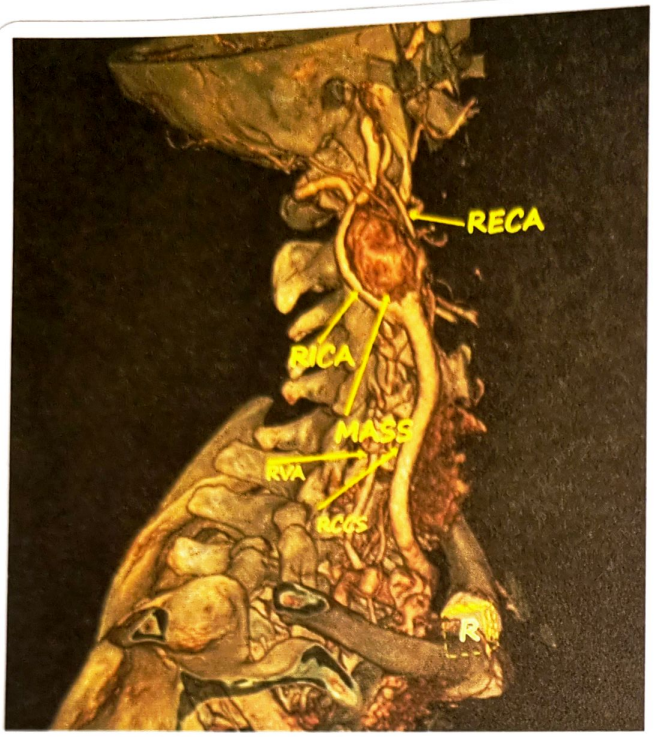
- Duplex scan
- CT contrast/MR angiogram

Lyre Sign**

- Angiogram finding—Splaying of internal and external carotids due to tumor in between
- Biopsy and FNAC are absolutely contraindicated



Conventional angiogram shows Lyre si



MR angiogram reconstructed showing Lyre sign

Treatment

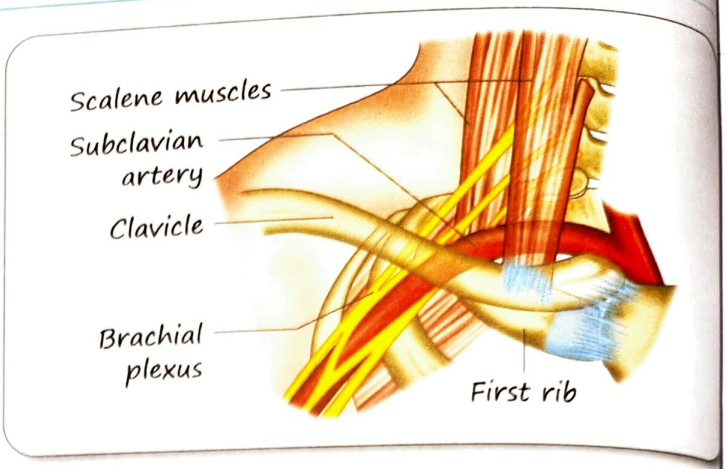
Shamblin classification of Types and Management

Types	Pattern	Surgical procedure
Type 1	Localized (25%)	Excision
Type 2	Adherent partially (50%)	Subadvential dissection (temporary intraluminal shunt may be used)
Type 3	Adherent completely surround Internal Carotid Artery (25%) cases	En bloc removal of tumor and ICA en bloc great saphenous vein grafting

Thoracic Outlet Syndrome

Applied Anatomy

Subclavian artery leaves the thoracic cage by passing over the first rib between scalenus anterior anteriorly and scalenus medius posteriorly along with brachial plexus



Thoracic outlet anatomy

Causes of Thoracic Outlet Syndrome

Congenital	Acquired
Osseous • **Cervical rib (Most common cause)**** • Long C_7 transverse process • Abnormal 1st rib	• Fracture clavicle, callus and pseudo arthrosis • Fracture 1st rib • Exostosis/tumors
Soft tissue: • Anomalous scalene insertion • Scalene muscle hypertrophy • Congenital bands and ligaments	• Scalene muscle injury • Previous surgery/scar • Soft tissue tumors • Direct brachial plexus injury
Postural: • Heavy breast • Sagging shoulders	

Must know:

Neurogenic symptoms	Vascular symptoms
MC nerve compressed is lower trunk of Brachial Plexus C8T1 (Ulnar nerve)	Intermittent occlusion of Subclavian artery resulting in Poststenotic aneurysm and distal emboli.
Clinical features: • Pain, paresthesia, along ulnar nerve distribution • Hallmark – pain in arm, shoulder, forearms	**Clinical features:** • Claudication • Ischemic ulcers • Gangrenous tips • Cold hands, color changes

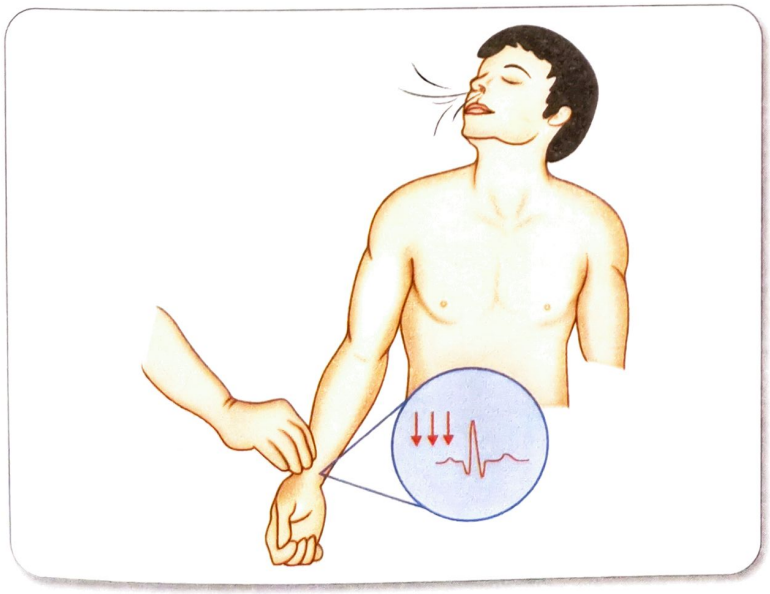
Clinical Features

- MC in 20–40 years
- 70% are females
- O/E—Pulsatile supraclavicular mass – due to Poststenotic aneurysm*
- Tinel's sign over brachial plexus
- Hard and fixed lump in lower part of posterior triangle** - Cervical rib.

Cervical rib and gangrene of fingers due to TOS

Investigations

Adson test	Roos test**	Halstead test	Wright test
• Extend arm • Turn to same side • Take a deep breath • Radial artery dynamicity decreases (not pulse rate)	• Abduct arm • Flex elbow • Open and close fist for 5 minutes • Claudication pain develops • Patient puts hand down	• Standing in military position • Turning to opposite side just opposite to Adson test • Check for pain and color changes in limb and for radial pulse	Hyperabduction of arm causes pain and decreases in radial pulse dynamicity



Adson test

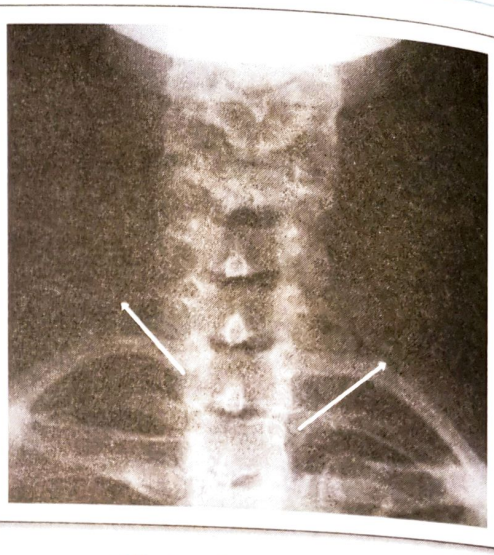
Roos' test (abduction with exercise)

Halstead maneuver

Wright hyperabduction test

Cervical Ribs:

- Costal element may develop from anterior part of the transverse process of C7 vertebra. This may develop into cervical rib.
- MC in right side
- Incidence: 0.45%
- 50% bilateral cases



Bilateral cervical ribs

Surgical Treatment

- Excision of cervical rib (extra periosteal excision
- Scalenotomy

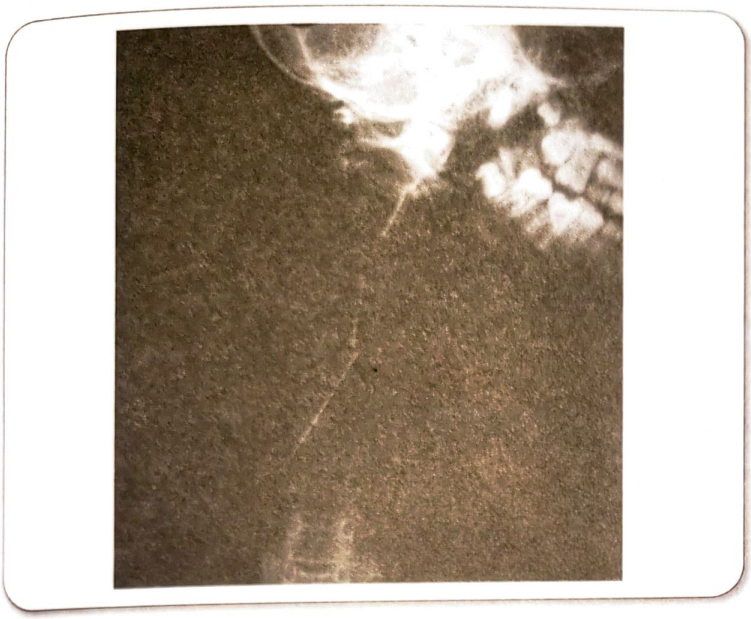
Branchial Cyst

- Cystic swelling arising from the persisten cervical sinus which is formed due to fusion 2nd branchial arch with 6th branchial arch.
- MC in young age (20–25 years)

Embryology

- 2nd branchial remnants are most common*
- 1st branchial remnants are MC located in fron or back of ear. (fistula seen between parotid an external auditory canal)
- 2nd branchial remnant is what discussed i detail below.
- 3rd branchial remnant is located at suprasterna or clavicular region*
- 15% of branchial sinuses are bilateral

Congenital branchial cyst



Fistulogram of 2nd branchial remnant

Differences between branchial cyst and branchial sinus/fistula

Branchial cyst	Branchial sinus/fistula
Swelling + in upper 1/3rd of Sternocleidomastoid muscle anteriorly	Opening seen in the neck anterior to SCM Congenital – Lower 1/3rd Acquired – Upper 1/3rd
Transillumination negative Thick content (contains cholesterol crystals- also seen in Hydrocele)	–
Lined by squamous epithelium**	Ciliated columnar epithelium**
Persistence of 2nd pouch	Congenital branchial sinus/fistula Inner opening - in tonsillar fossa Anterior to the posterior pillar**
Complications: • Recurrent infection • Acquired branchial sinus due to inadvertent incision or infection and rupture of cyst • Branchiogenic carcinoma - Can have squamous or columnar epithelium	Fistula passes through Bifurcation of common carotid Pierces superior constrictor of pharynx Tonsillar fossa
Treatment: Complete excision of cyst	Multiple stepladder incision – follows fistula and removes it completely • Hypoglossal nerve, glossopharyngeal nerve and spinal accessory nerve lie deep to the cyst and are at danger during surgery. • Medially it can extend up to the pharyngeal wall.

Contd...

Branchial Sinus

Failure of fusion of the second branchial arch with sixth branchial arch and persistence of cervical sinus results in this condition. In most cases, the internal opening is not found, so this is better called a sinus rather than a fistula.

- **Congenital**: Persistent cervical sinus
- Acquired

External Opening

- **Congenital**: Typically located in lower 1/3rd of neck at the anterior border of sternocleidomastoid.
- **Acquired**: Typically located at upper 1/3rd to middle 1/3rd junction.

Bilateral congenital branchial fistula

Internal Opening

Behind the tonsil and anterior to posterior pillar of the fauces in the lateral wall of the pharynx lies the interior opening.

Treatment

Excision of fistulous tract.

Cystic Hygroma

- Sequestration of a portion of jugular lymph sac from lymphatic system accounts for the appearance of these swellings in the neck.
- It is a swelling in the **posterior triangle** of neck in the lower third.
- **Earliest swelling** one can see in the neck.
- Cystic hygroma is **present in neonate** or in early infancy.
- It may also be present at birth as obstructed labor.
- Swelling is **brilliantly translucent** and **partly compressible, cough impulse is also positive.**
- Cysts are **filled with clear lymph** and lined with a single layer of epithelium.

Cystic hygroma

- Recently sclerosants like BLEOMYCIN and streptococcal pyogenes derivatives like PICIBANIL (OK432) injected into the lesions.

Thyroglossal Cyst

- Cystic swelling developing in the remnant o thyroglossal duct or tract.
- Present in any part from thyroglossal trac foramen cecum to isthmus.
- MC sites—subhyoid, region of thyroid cartilage suprahyoid, in floor of mouth, beneath forame cecum.
- Midline swelling shifted to left at level of thyroi cartilage.
- MC age—15–30 years.
- Cyst can be moved sideways but not vertically.
- Moves with deglutition and protrusion of tongu
- Lined by pseudostratified columnar epithelium.

Thyroglossal cyst

Complications

- Infection
- Fistula
- Papillary carcinoma can develop.
- Thyroglossal cyst is congenital but fistula is always acquired** due to improper drainage or surgery inadequate.

Sistrunk Operation

- Excision of tract along with excision of central part of hyoid bone.
- Sistrunk operation is also named for filarial leg surgery**.